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ABSTRACT

Weatherlinker is a unit of curriculum materials designed to enhance the study of meteorological science at the seventh-grade level and to enrich that study through the use of various types of technology. This document consists of a teacher's guide, student handouts, information on telecommunications, and a list of materials that were used by the field sites. Suggested classroom teaching strategies include the use of instructional learning centers, individual activities, and opportunities for small and large group instruction. Topics of instruction include weather stations for observing air temperature, relative humidity, wind, and air pressure; and weather forecasting. Evaluation materials are provided. The telecommunications handbook focuses on the FREDMAILER System available to teachers in the state of North Carolina. (CW)

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TEACHER'S GUIDE

SECTION A

FOREWORD

WEATHERLINKER is a unit of curriculum materials to enhance the study of meteorological science at the seventh grade level and to enrich that study through the use of various types of technology. It is the result of a joint effort by consultants in science and in computer services and was field-tested and evaluated by North Carolina science teachers in the Spring of 1988. Funding for WEATHERLINKER was provided through the Title II--Education for Economic Security Act.

The use of WEATHERLINKER should be a cooperative teaching experience in which system-level computer coordinators and science coordinators work with classroom teachers and media coordinators to produce a rewarding experience for students. The printed materials for WEATHERLINKER consist of a teacher's guide, student handouts, information on telecommunications, and a list of the materials that were used by the field-testing sites. Suggested classroom teaching strategies include the use of instructional learning centers, individual activities, and opportunities for small and large group instruction. However, the classroom can be successfully organized for only large group instruction when the teacher prefers this teaching technique.

A public domain computer program for the Apple Computer and a video tape have been prepared as supplements to the printed materials. The computer program has been included with the printed materials. The video tape is available for copying at the eight North Carolina regional centers. A variety of suggested materials are listed in Section D of the Teacher's Guide. No doubt, there are other commercially prepared computer programs and video tapes that would serve as good supplemental materials. However, teachers should preview titles before using them with the WEATHERLINKER materials.

To further enrich the study of meteorology, telecommunications has been included as a culminating activity. North Carolina teachers will use the FREDMAILER Telecommunications Network for this WEATHERLINKER activity. Site maps and telephone numbers have been included in the teacher's guide. Any teacher who will be using WEATHERLINKER should contact their local school system computer coordinator for assistance in communicating with the FREDMAILER node nearest their school well in advance of the project. The teacher will need to be validated by the local sysop (system operator) and be established as a WEATHERLINKER participant. The SCIENCE BULLETIN BOARD within the FREDMAILER System will be used to exchange weather data during the project.

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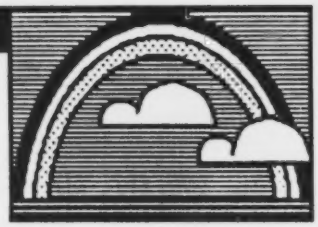
INTRODUCTION - FIRST DAY



OVERVIEW ➡➡➡➡➡➡➡➡➡

PURPOSES:

- to provide students with a working knowledge of weather and weather forecasting with a focus on conditions in North Carolina

- to instruct students in the utilization of computer technology in the gathering, storage, dissemination, and analysis of weather data and the forecasting of future conditions

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ WEATHERLINKER video
- ✓ Scenario (HANDOUT #1)
- ✓ Questions and Answers sheet for each student (HANDOUT #2)
- ✓ Daily Weather Forecast (HANDOUT #3)

DIRECTIONS ➡➡➡➡➡➡➡➡➡

It is suggested that each student keep all materials associated with the study in a looseleaf science notebook or folder or large envelope.

Introduce the study of weather with the following scenario (This may be prerecorded on cassette tape or students may read from a printed sheet (HANDOUT #1)):

At the end of your study of weather, you will furnish important information for a team of students who will be taking part in a survival weekend adventure. At present, no one is at liberty to disclose to you the exact location at which the event will be held. However, the adventure will take place in North Carolina. In order for the team to make good decisions as to clothing, food, and shelter that will be needed, it will be necessary for them to have weather forecast information for the weekend. You will prepare a weather forecast for the team based on your study of local and state-wide weather conditions. This information will include: predicted temperatures, cloud cover, precipitation, wind speed and direction, relative humidity, and air pressure.

ACTIVITIES ➡➡➡➡➡➡➡➡➡

Introduction and viewing of the weather video:

We get information on weather conditions from varied sources - the radio, TV, newspaper, amateur forecasters on the street, and even through online sources via computer and modem. Behind the scenes, many people are using specialized equipment to gather the data that is necessary so that a forecast can be made. This equipment is located all over the world--for someone's weather yesterday may be our weather today or at least will have an effect on what our weather will be. The following video was filmed at one of these data collecting centers in North Carolina. Please note the different aspects of weather that are covered and how computers are used in the organization and presentation of the information.

After a discussion of the video, distribute HANDOUT #2 and discuss.

ASSIGNMENTS ➡➡➡➡➡➡➡➡➡

Beginning today and continuing throughout the project, students will be encouraged to follow the weather through radio,TV or newspaper reports. If possible, the Media Coordinator may tape AM Weather at 6:45 A.M. on Public Television or the 6 P.M. weather report from the local TV station for group or individual viewing. The Daily Weather Forecast Sheet (HANDOUT #3) may be introduced at this time for students to record TV weather information in parts A and B. (In order to conserve paper, students may use the Daily Weather Forecast Sheet as a model and make their recordings on notebook paper.)

At the end of your study of weather, you will furnish important information for a team of students who will be taking part in a survival weekend adventure. At present, no one is at liberty to disclose to you the exact location at which the event will be held. However, the adventure will take place in North Carolina. In order for the team to make good decisions as to clothing, food, and shelter that will be needed, it will be necessary for them to have weather information for the weekend. You will prepare a weather forecast for the team based on your study of local and state-wide weather conditions. This information will include: predicted temperatures, cloud cover, precipitation, wind speed and direction, relative humidity, and air pressure.

Question 1: What is weather?

Answer: Weather is the condition of the atmosphere, e.g., fog is minute particles of water or ice hanging in suspension in the air.

Question 2: In what part of the atmosphere does weather occur?

Answer: Weather, as we experience it, generally occurs within the lowest forty thousand feet of the atmosphere.

Question 3: What are some ways in which weather can affect our daily lives?

Answer: Recreation; travel; clothing; sports; agriculture; outdoor jobs such as construction, fishing, etc.

Question 4: What types of violent or hazardous weather conditions may affect people in North Carolina?

Answer: Coastal: Hurricanes and nor'easters
Piedmont: Tornadoes and severe droughts
Mountain: Heavy snows and ice storms

Question 5: What are some factors that make weather forecasting difficult in North Carolina?

Answer:

- The Gulf Stream modifies air temperatures and alters weather system movement.

- Geographic features (mountains, flatlands, and coastal environment) strongly modify passing air masses.

- The latitude in which North Carolina is situated is in the direct path of major storm systems, particularly in winter. The location is where upper atmospheric flow patterns characteristically shift toward a northeast direction. Surface weather systems are redirected toward the northeast and over the ocean.

Question 6: What are the components of weather that change daily?

Answer: clouds (amount, type, height)
precipitation (amount, type, intensity)
temperature
moisture content (water vapor)
wind (direction, speed)
atmospheric pressure (weight)
restrictions to visibility (smoke,smog, dust,salt, fog, haze)
hazardous/unhealthy conditions (pollen, acid rain)

HANDOUT #3

Daily Weather Forecast

NAME: _____ SCHOOL: _____

GROUP/CLASS: _____ TEACHER: _____

DATE: _____

A.

Time _____

Temp. _____

Relative Humidity _____ %

Barometric Pressure _____ in.

_____ rising _____ steady _____ falling (check one)

Precipitation

Type _____ Amount _____ in.

Winds

Speed _____ m.p.h.

Direction _____

B.

Cloud Cover (check one)

____ clear ____ 3/4 cover

____ 1/4 cover ____ overcast

____ 1/2 cover

Types of Clouds _____

Drawing below of major cloud formations:

C. Forecast for Tomorrow

Skies

_____ clear

_____ partly cloudy

_____ cloudy

Precipitation

_____ yes _____ no _____ maybe

Type predicted _____

Temp. _____ C° high _____ C° low

Wind _____ speed _____ direction _____ shifts

Relative Humidity _____ %

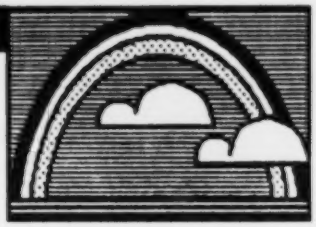
D. Accuracy of Prediction

for _____ (date)

Reported	Correct (check)
Skies _____	_____
Precipitation _____	_____
Temperature	
High _____ C°	_____
Low _____ C°	_____
Wind _____ m.p.h.	_____
_____ direction	_____
Humidity _____ %	_____

5 A

INTRODUCTION - SECOND DAY



OVERVIEW ➡➡➡➡➡➡➡➡➡

- An introduction and explanation of the five major components of weather - air temperature, relative humidity, clouds, wind, and air pressure.

- Also included today is an introduction to the student laboratory rotational schedule for days 3 - 10 of the project.

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓SCIENCE TOOLKIT
- ✓ Questions and Answers sheets (HANDOUTS #4, 7, 10, 12)
- ✓ CASTLES IN THE SKY filmstrip
- ✓ Compass
- ✓RANGER RICK'S NATURESCOPE: "Mild and Wild Weather", p.26
- ✓ Signs for the four cardinal points, optional
- ✓ Daily Weather Forecast transparency (TRANSPARENCY #1)

DIRECTIONS ➡➡➡➡➡➡➡➡➡

Lead the class in a discussion of the HANDOUTS and other basic concepts:

Air Temperature	(HANDOUT #4) Review the answers to questions 1-3. Demonstrate how the temperature strip chart with SCIENCE TOOLKIT can be used to collect data.
Humidity	(HANDOUT #7) Quickly review the term "relative" and discuss the handout.
Clouds	Use the Information in "Mild and Wild Weather", p. 26, RANGER RICK'S NATURESCOPE, as an introduction to clouds. Show filmstrip, "Castles in the Sky."
Wind	(HANDOUT #10) Use the compass on the overhead to show how wind direction is determined by locating the cardinal points. Directional signs may be attached to walls, windows, etc.

6 A

Air Pressure — (HANDOUT #12) Explain the answers to questions 6-12. Demonstrate the effects of air pressure by using the example, "Collapse-the-Can."

COLLAPSE-THE-CAN

Use an empty ditto fluid can and wash it several times so that it is very clean, inside and outside. Put a small quantity (50 ml.) of water inside the can and place it on a heat source such as a hot plate. (Do not put the cap on the can!) Once water vapor can be seen leaving the mouth of the can, remove the can from the heat (use a hot pad), carefully put the cap on and immerse it in a bucket of cool water. Explain that the contracting water vapor reduced the pressure inside the can which allowed the normal air pressure to push the walls of the can together. A better technique would be to let the students explain the phenomena.

ACTIVITIES ➡➡➡➡➡➡➡➡➡

Divide the class into four lab groups (stations) with approximately the same number of students in each group. Each group will spend two days conducting activities at each of the four lab stations (8 days). Students should read any handouts or instructions related to a lab station before beginning the station activities. The teacher should have materials ready for each station and spend most of the class time circulating among the groups to help facilitate the activities.

The following chart shows a suggested rotational pattern for the four groups during days 3 - 10 of the weather unit:

	GROUP #1	GROUP #2	GROUP #3	GROUP #4
Days 3 - 4	air temperature	wind	air pressure	humidity/clouds
Days 5 - 6	humidity/clouds	air temperature	wind	air pressure
Days 7 - 8	air pressure	humidity/clouds	air temperature	wind
Days 9 - 10	wind	air pressure	humidity/clouds	air temperature

For the teacher, the rotational period (days 3 - 10) will seem like a two-day cycle that repeats four times. For example, on Day 3 of the unit, all four lab groups will be conducting first-day activities dealing with their specific lab topic. On Day 4 all groups will be on the second day of a topic. On Day 5 all groups will rotate to a new topic and a second cycle will begin.

Below are suggested teacher activities for the first and second days of each cycle:

First-day Teacher Activities	Second-day Teacher Activities
• Begin by helping the **WIND** station read their compass to determine wind direction.	• Assist the **WIND** station with their final calculations to determine wind speed.
• Watch the **AIR PRESSURE** station to make sure they conduct their activities safely.	• Make sure the **AIR PRESSURE** station is working and tell them how and when to collect their pressure data each day.
• Help the **HUMIDITY/CLOUDS** station with reading charts (or using the computer program) to determine relative humidity. Show them how to read the classroom barometer.	• Encourage the **HUMIDITY/CLOUDS** station to move along quickly with their drawings. Indicate to them exactly where they are to be while completing the activity.
• Show the **AIR TEMPERATURE** station how to draw isothermal lines on their maps.	• Make sure that the **AIR TEMPERATURE** station understands their task and gets started.

NOTE: At the end of each class during the rotation schedule, the teacher should use the Daily Weather Forecast transparency (TRANSPARENCY #1) to summarize and compile any data that has been collected by the stations. The collected data should be compared with the information given by local television and radio forecasters.

Question 1: What is air temperature?

Answer: Air temperature is the measure of heat or radiant energy from the sun that is released into the atmosphere by surfaces or substances on earth and is transferred to air molecules.

Question 2: Why is air (atmospheric) temperature important to know?

Answer: Air temperature affects the density (weight) of air as well as the amount of water vapor that can be held (suspended) in a given amount of air. As air is heated it expands and fewer molecules are in the same space. The heated air is less dense and therefore rises. Cooler air is more dense and therefore falls. This rising and falling of air causes circulation patterns to be established that results in the formation of winds and the movement of air masses across the earth.

Question 3: What factors affect air temperature?

Answer:

- The uneven heating of surfaces on earth affect air temperature. Dark, rough surfaces such as plowed fields absorb the sun's energy much better than do reflecting surfaces such as water or light surfaces.
- Land surfaces concentrate heat at their surfaces and therefore lose heat very rapidly. When water is heated it distributes heat throughout and therefore loses heat more slowly.
- Cloud cover at night tends to reflect heat back to the earth. This prevents heat loss and tends to cause air temperatures to be higher than temperatures would be on a clear night. The opposite is often the case during the day. Increased amounts of CO_2 and other air pollutants reflect heat back to earth. This has come to be known as the "Greenhouse Effect."
- Increases or decreases in water vapor in the air affect heat retained in the atmosphere as well as various sky conditions such as fog and clouds.
- Altitude affects air temperature also. For every 1000 feet rise in elevation, air temperature decreases by 3.5° F.
- Seasonal and daily cycles also cause changes in air temperature. The rotation of the earth and the revolution of the earth around the sun cause differences in the amount and intensity of solar radiation reaching areas of the earth's surface.

Question 4: What causes high and low temperatures to occur in the atmosphere?

Answer: High and low temperatures are the result of the accumulation of heat energy being radiated into the atmosphere during the sunlight hours and the loss of heat energy without replenishing it during the night.

Question 5: When do the high and low temperature readings occur?

Answer: There is a lag time in which the surfaces of the earth give off energy as they receive it from the sun. One might expect the noontime to be the hour for the high temperature reading, but the surfaces retain for a while the solar energy that has been absorbed. This energy is released into the atmosphere to create a high reading between 2 and 4 p.m. on an average day. The low temperature reading usually occurs just before sunrise.

Question 6: How is air temperature measured?

Answer: Air temperature is measured with any type of thermometer. The thermometer needs to be calibrated if accurate reporting of temperatures is to be done.

Question 7: How can a thermometer be calibrated?

Answer: There are several methods. The following is a simple process: Fill a styrofoam cup with crushed ice in a small amount of water. Place the bulb end of the thermometer about two centimeters in the ice. Leave the thermometer in the ice for at least two to four minutes. Remove the thermometer from the ice and read the temperature. The reading shoud be 0° C. or 32° F. If the thermometer shows a different reading, add or subtract the degrees necessary to made the reading 0°C. or 32°F. The number of degrees that are added or subtracted is the degree of error for the thermometer. This number will have to be added or subtracted each time the thermometer is used. Label the thermometer with its degree of error.

To adjust the thermistor in SCIENCE TOOLKIT see page 30 in manual.

Question 1: What determines the three states of water?

Answer: Water is found in three conditions or states: Liquid, solid (ice), or gas (water vapor). The state is determined by both temperature and surrounding pressure (usually air pressure).

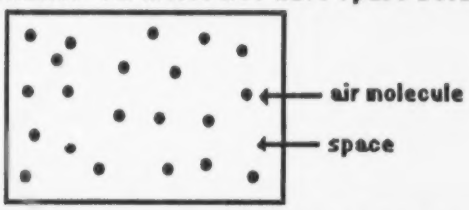
Question 2: How can we describe water vapor or the gaseous state of water in the air?

Answer: Water vapor CANNOT - be seen - be felt - be smelled - be tasted! It is all around us but we cannot directly sense it. There are some indirect indicators of water vapor in the atmosphere:

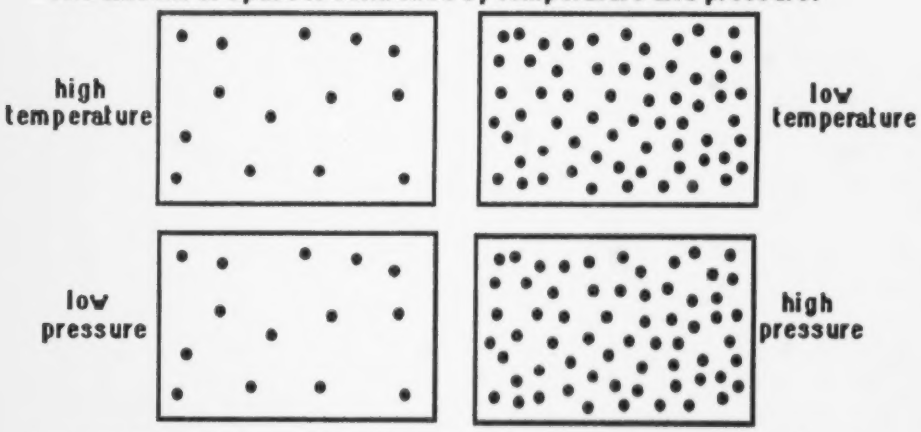
- We are physically uncomfortable when the water vapor is high (muggy, damp, etc.).
- Static electricity is in the air when there is a low amount of water vapor.
- Cold surfaces (drinking glasses) "sweat" in high amounts of water vapor.

Question 3: What is relative humidity?

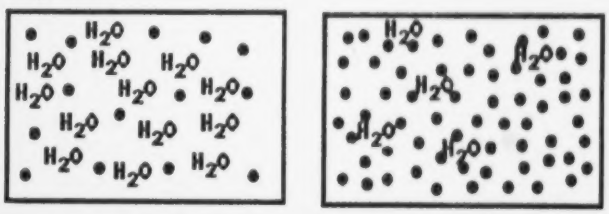
Answer: Relative humidity is only one method of describing "how much water vapor the atmosphere contains." Air molecules have space between them.



The amount of space is controlled by temperature and pressure.



The amount of space determines the number of water vapor molecules that can be present.

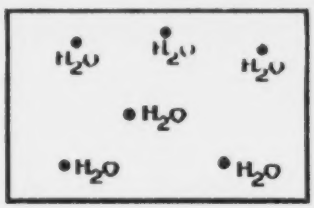


As you can see, the diagram on the left indicates conditions where more water vapor molecules can be present.

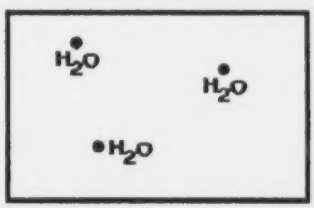
Question 4: How is relative humidity determined? HANDOUT # 7

Answer: Relative humidity is a percentage or ratio of how much water vapor is actually present compared to how much the air could possibly hold at the present temperature and pressure.

This air parcel at 20°C. can possibly hold six water vapor molecules.



However, for some reason (and usually the reason is how much water vapor is available) the air has only three water vapor molecules.



This air actually has 1/2 of the water vapor molecules that it could have at the present temperature. We say that this air has a relative humidity of 1/2 or 50%.

When the air has all the water vapor it can possible hold, the relative humidity is 100%.

Question 5: What happens to relative humidity when the temperature is changed?

Answer: We know that as the temperature is lowered, the space between the molecules will decrease. If the air at 20° C. has enough space for six water vapor molecules then as the temperature changes to 10° C. the amount of space available for water vapor molecules is 1/2 as much or three. That means at 20° C. with three water vapor molecules present, the relative humidity is 50%. With NO CHANGE in water vapor content (3 molecules) and a temperature reduction to 10° C., all available space for water vapor molecules is occupied. The relative humidity is 100%.

QUESTIONS AND ANSWERS - WIND

HANDOUT #10

Question 1: What is wind?

Answer: Wind is air in motion.

Question 2: What causes wind?
Temperature or heat differences between areas. (See questions on temperature.)

Question 3: What causes differences in wind strength?

Answer: The difference in heat from one place to another determines wind strength (Great difference - strong wind / little difference - no wind).

Question 4: What causes differences in wind direction?

Answer: The primary factor in wind direction is the rotation of the earth. Other causes include physical features such as mountain ranges, shorelines, vegetation, and large areas of concrete such as parking lots. The passage of weather fronts is also a contributing factor.

Question 5: Where does wind occur?

Answer: Anywhere in the atmosphere.

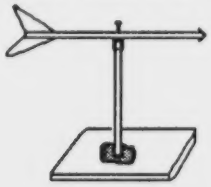
Question 6: Why is wind important?

Answer: Wind affects many of our daily activities -- aviation, sailing, farming, and recreation.

Question 7: How is wind measured?

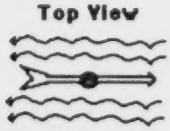
Answer: Two features are considered in the measurement of wind -- direction and speed.

WIND VANE - Measures wind direction



ANEMOSCOPE - Measures wind speed

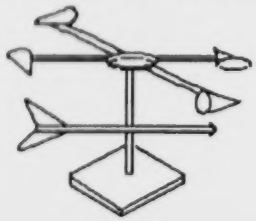
Top View



A. EAST

B. NORTHWEST

ANEMOMETER - Measures wind direction and speed



Question 1: What is the atmosphere?

Answer: The earth is surrounded by a huge sphere of air that stretches from the surface of the earth to the beginning of outer space. This sphere of air is called the atmosphere and is often described as an ocean of air that constantly changes due to currents, waves, and tides. The atmosphere is divided into layers stacked one on top of the other.

Question 2: What is the troposphere?

Answer: The layer of the atmosphere that is closest to the earth's surface is called the troposphere. It is about 8 miles thick and contains nearly 90% of all the moisture and over half of the air in the atmosphere. This is the layer in which nearly all life on the earth exists. Almost all of the weather events that we observe take place in this layer.

Question 3: What is the stratosphere?

Answer: The layer above the troposphere is known as the stratosphere and extends up to an altitude of about 50 miles above the earth's surface. This layer contains a band of ozone which is a form of oxygen that is made up of three oxygen atoms rather than two atoms like the oxygen we normally breathe. Ozone is responsible for filtering out most of the harmful ultraviolet radiation that the sun directs toward the earth.

Question 4: What is the ionosphere?

Answer: The ionosphere rests above the stratosphere. This layer gets its name from the small charged particles that exist there known as "ions." In this layer strong radiation from the sun knocks electrons off oxygen molecules creating ions. These ions are able to reflect radio waves, thereby making it possible for us to conduct long distance broadcasts around the earth. The ionosphere extends up to about 250 miles above the earth.

Question 5: What is the exosphere?

Answer: The exosphere is the beginning of interstellar space.

Question 6: What does the atmosphere do for the earth? HANDOUT #12

Answer: When compared to the thickness of the earth, the atmosphere is only a thin blanket surrounding the globe. This blanket consists of about 80% nitrogen and 20% oxygen plus a few other traces of gases. The atmosphere protects us from bombardment of meteors and harmful temperature extremes. Without its protection, surface temperatures would reach 200°F. (93°C.) during the day and about -280°F. (-137°C.) at night.

Question 7: How could the atmosphere be described?

Answer: We think of air as being colorless, odorless, and weightless. The first two descriptions are true, but air in the atmosphere does have weight.

Question 8: Why does the atmosphere have weight?

Answer: The atmosphere is held around the earth by the force of gravity. As one approaches the earth from outer space, each layer of the atmosphere is thicker and heavier. All of the air in the atmosphere is stacked above the earth's surface causing a pressure on all objects on or near the earth.

Question 9: How much does the atmosphere weigh?

Answer: About one ton (2,000 lbs.) of air pushes against each square foot of the earth's surface. This is about 14.7 lbs. per square inch.

Question 10: Why doesn't all this weight crush us?

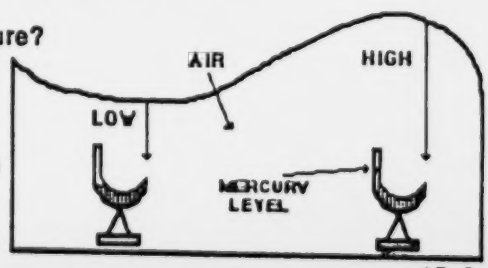
Answer: Fortunately, we are accustomed to this amount of pressure and it is not felt by us. This is due to the fact that the pressure is exerted in all directions in the atmosphere and that it equalizes so that we do not feel pressure from only one direction. Otherwise, we might be flattened like a pancake.

Question 11: How do we measure air pressure?

Answer: A barometric tube of mercury can be used to weigh air. The rising or falling mercury tells us if the air pressure is high or low. The vertical height of the atmosphere behaves like the ocean with crests and troughs. On weather forecasts the barometric pressure is usually given in inches of mercury.

Question 12: Why do we need to measure air pressure?

Answer: Because most storms occur in low pressure areas, a barometer can be a very important instrument. Changes in air pressure may reflect a change in the weather.



Daily Weather Forecast

DATE _____

Time_____

Temp. _____°C

Relative Humidity _____ %

Barometric Pressure _____ in.

____ ____ ____ (check one)
rising steady falling

Precipitation

Type_____ Amount _____ in.

Winds

Speed _____ m.p.h.

Direction _____

16 A

21

Cloud Cover (check one)

___ clear ___ 3/4 cover

___ 1/4 cover ___ overcast

___ 1/2 cover

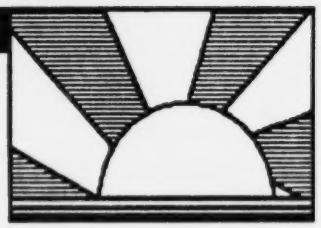
Types of Clouds _____

Draw major cloud formations below:

TRANSPARENCY #1

22

AIR TEMPERATURE STATION - FIRST DAY



OVERVIEW ➡➡➡➡➡➡➡➡➡

Air temperature is one of the basic concepts in the study of weather. Air temperature is the degree of hotness or coldness of the air and it is measured by a thermometer in Fahrenheit or Celsius. In our study we will use the Celsius scale. For the first day of this study, students will use thermometers and thermistors to discover some principles of air temperature and how temperature is indicated on a weather map.

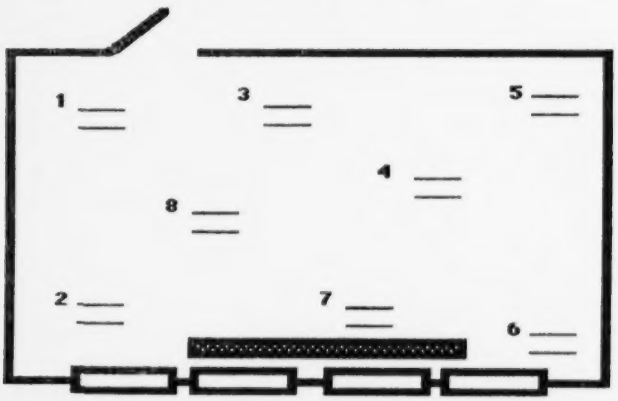
YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ Questions and Answers sheet for each student (HANDOUT #4)
- ✓ SCIENCE TOOLKIT with extension cable
- ✓ Calibrated thermometers and thermistor (At least 6 thermometers)
- ✓ Classroom map for each student (see directions)
- ✓ Isothermal Lines map (MASTER #1)
- ✓ WEATHERLINKER diskette

DIRECTIONS ➡➡➡➡➡➡➡➡➡

Review Questions and Answers sheet (HANDOUT #4). If students need practice in reading thermometers, let them practice using the "Thermometer" program on the WEATHERLINKER diskette.

Prepare a simple map of the science classroom. Indicate locations of doors, windows, and heat/air conditioners. Temperature reading stations may also be indicated and numbered on the map. The number of stations will depend on the number of thermometers available. This map can be made into a transparency for group viewing.



The students who are taking room temperatures may be divided into two groups. One group can use the thermometers and the other the thermistor from the SCIENCE TOOLKIT.

Before the end of class, help students prepare the SCIENCE TOOLKIT to record outside temperature over a 24-hour period and create a strip chart of the data. Use an extension cable in order to get the thermistor well outside the window. The results of the chart will be discussed in class on the second day of this station.

ACTIVITIES ➡➡➡➡➡➡➡➡➡➡

Preparation of Thermometers

Carefully push a thermometer one to two inches through the bottom portion of a styrofoam cup. With a pencil, make holes in the cup. These holes should be distributed evenly around the cup. The cup will serve as insulation from the elements so that a more accurate reading can be made.

Isothermal Map of Classroom

To ensure even distribution of data, students should position themselves randomly throughout the room. Each student will be given a number which will be the number for his/her temperature station. Be certain that some students are near windows, doors, and heat/air conditioners. At each station, take temperature readings from two heights 1) on the floor and 2) at the top of the desks. Allow the thermometers to reach their equilibrium (stabilize) before readings are made. Have all students read thermometers at a given signal. Each student will first record the temperature and then report the temperature of his/her station when his/her station number is called. All students will record the temperatures for all reporting stations on a paper classroom map. The teacher or a designated person will record the temperatures on a group map or transparency. This activity is done in two steps--first the floor readings and then the desktop readings.

After the temperature data is recorded, the teacher can introduce the concept of **isothermal maps** and **isolines** by using the Isothermal Lines transparency (MASTER # 1) or a weather map from the daily newspaper. (Also refer to WEATHERWORKS 4D.01a and 7D.01a --see List of Suggested Materials, Section D.) Demonstrate on the group map or transparency how to create an **isothermal map** with **isolines.**

Strip Chart

Using SCIENCE TOOLKIT and an extension cable, make the necessary preparations to create a 24-hour strip chart. The results will be discussed on the second day of this station.

ASSIGNMENTS ➡➡➡➡➡➡➡➡➡➡

Students create isothermal maps using individual classroom maps and classroom temperature data.

Question 1: What is air temperature?

Answer: Air temperature is the measure of heat or radiant energy from the sun that is released into the atmosphere by surfaces or substances on earth and is transferred to air molecules.

Question 2: Why is air (atmospheric) temperature important to know?

Answer: Air temperature affects the density (weight) of air as well as the amount of water vapor that can be held (suspended) in a given amount of air. As air is heated it expands and fewer molecules are in the same space. The heated air is less dense and therefore rises. Cooler air is more dense and therefore falls. This rising and falling of air causes circulation patterns to be established that results in the formation of winds and the movement of air masses across the earth.

Question 3: What factors affect air temperature?

Answer:

- The uneven heating of surfaces on earth affect air temperature. Dark, rough surfaces such as plowed fields absorb the sun's energy much better than do reflecting surfaces such as water or light surfaces.
- Land surfaces concentrate heat at their surfaces and therefore lose heat very rapidly. When water is heated it distributes heat throughout and therefore loses heat more slowly.
- Cloud cover at night tends to reflect heat back to the earth. This prevents heat loss and tends to cause air temperatures to be higher than temperatures would be on a clear night. The opposite is often the case during the day. Increased amounts of CO_2 and other air pollutants reflect heat back to earth. This has come to be known as the "Greenhouse Effect."
- Increases or decreases in water vapor in the air affect heat retained in the atmosphere as well as various sky conditions such as fog and clouds.
- Altitude affects air temperature also. For every 1000 feet rise in elevation, air temperature decreases by 3.5° F.
- Seasonal and daily cycles also cause changes in air temperature. The rotation of the earth and the revolution of the earth around the sun cause differences in the amount and intensity of solar radiation reaching areas of the earth's surface.

Question 4: What causes high and low temperatures to occur in the atmosphere?

Answer: High and low temperatures are the result of the accumulation of heat energy being radiated into the atmosphere during the sunlight hours and the loss of heat energy without replenishing it during the night.

Question 5: When do the high and low temperature readings occur?

Answer: There is a lag time in which the surfaces of the earth give off energy as they receive it from the sun. One might expect the noontime to be the hour for the high temperature reading, but the surfaces retain for a while the solar energy that has been absorbed. This energy is released into the atmosphere to create a high reading between 2 and 4 p.m. on an average day. The low temperature reading usually occurs just before sunrise.

Question 6: How is air temperature measured?

Answer: Air temperature is measured with any type of thermometer. The thermometer needs to be calibrated if accurate reporting of temperatures is to be done.

Question 7: How can a thermometer be calibrated?

Answer: There are several methods. The following is a simple process: Fill a styrofoam cup with crushed ice in a small amount of water. Place the bulb end of the thermometer about two centimeters in the ice. Leave the thermometer in the ice for at least two to four minutes. Remove the thermometer from the ice and read the temperature. The reading shoud be 0° C. or 32° F. If the thermometer shows a different reading, add or subtract the degrees necessary to made the reading 0°C. or 32°F. The number of degrees that are added or subtracted is the degree of error for the thermometer. This number will have to be added or subtracted each time the thermometer is used. Label the thermometer with its degree of error.

To adjust the thermistor in SCIENCE TOOLKIT see page 30 in manual.

ISOTHERMAL LINES

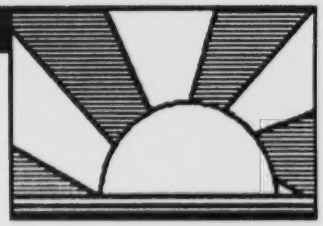
MASTER #1

21 A

27

28

AIR TEMPERATURE STATION - SECOND DAY



OVERVIEW ➡➡➡➡➡➡➡➡➡

Students will continue their study of air temperature and how different surfaces of the earth are affected. They will discover how hot air tends to rise.

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ SCIENCE TOOLKIT
- ✓ 5 thermometers
- ✓ light source (75W incandescent bulb or sunlight)
- ✓ 2 7oz. styrofoam cup 2/3 filled with water at room temperature
- ✓ 4 7oz. styrofoam cups 2/3 filled with sand (two moist and two dry)
- ✓ 4 7oz. styrofoam cups 2/3 filled with potting soil (two moist and two dry)
- ✓ graph paper for each student
- ✓ graph transparency (optional)
- ✓ Temperature Data Chart (HANDOUT # 5)
- ✓ 2 small paper bags
- ✓ yardstick or meterstick
- ✓ string and tape
- ✓ candle and matches
- ✓ Soaring Bird worksheet (HANDOUT # 6)

DIRECTIONS ➡➡➡➡➡➡➡➡➡

Begin the day with a discussion of the isothermal maps the students have prepared and let them compare their maps with the group map or transparency completed during the first day of this station. Continue the discussion by pointing out to students how difficult it is to assign one temperature to the classroom. (Ask where they might locate a thermometer for the most accurate reading.) Relate this to the placement of a thermometer outside.

Make several printouts of the strip chart that shows the outside temperature over the past 24 hours and distribute these to the group. Discuss the temperature ranges and ask leading questions which will point out the hours when the temperature was lowest, highest, etc.

Divide the students into three groups for the activities:

ACTIVITIES ➡➡➡➡➡➡➡➡➡➡

Surfaces of Earth and Temperature (GROUP 1)
Distribute HANDOUT #5 to students for recording data.
Number the styrofoam cups in the following order:
#1 water; #2 dry sand; #3 moist sand; #4 dry potting soil; #5 moist potting soil
The filled cups should be set in a circle under a light source. The light source should be no higher than 35 cm above the cups.

- Place a thermometer in each cup. The bulb of the thermometer should be in the material to a depth of 1/2 cm. (Thermometers may need to be supported .)
- After thermometers have been in place in the cups for 2 minutes, record the temperature in each cup. Students can use a data chart or copy an example that is given by the teacher.
- Turn on the light source. Record temperature readings after 5, 10, and 15 minutes.
- Turn off the light source. Record temperature readings after 5, 10, and 15 minutes.
- From the recorded data, each student could prepare a graph of the results. Students may compare their graphs with a graph transparency prepared by the teacher.

Surfaces of Earth and Temperature (GROUP 2)
For this activity, the group will follow the same directions as GROUP 1 except they will use SCIENCE TOOLKIT and the thermistor to determine temperatures. The time for recording temperatures may need to be shortened due to having only one thermistor.

Hot Air Rises (GROUP 3)
With string and tape, attach a paper bag to each end of a yardstick or meterstick so that each bag hangs freely. Tie another string around the center of the stick and hang this to the ceiling or allow a student to hold it until the bags are balanced. Light a candle and hold it under one of the bags. After a minute or two, remove the candle. Discuss what happened to the air when it was heated. What happened when the candle was removed?

ASSIGNMENTS ➡➡➡➡➡➡➡➡➡➡

Distribute HANDOUT #6 and have students draw the flight path of the soaring bird. Make sure they understand that the bird is gliding on the air currents. Students can compare their drawings with a teacher-completed activity sheet which can be used as a transparency or a paper copy for group study.

HANDOUT #5

TEMPERATURE DATA CHART

	TEMPERATURE AFTER 2 MINUTES	TURN ON LIGHT SOURCE	TEMPERATURE AFTER 5 MINUTES	TEMPERATURE AFTER 10 MINUTES	TEMPERATURE AFTER 15 MINUTES	TURN OFF LIGHT SOURCE	TEMPERATURE AFTER 5 MINUTES	TEMPERATURE AFTER 10 MINUTES	TEMPERATURE AFTER 15 MINUTES
CUP # 1 WATER									
CUP # 2 DRY SAND									
CUP # 3 MOIST SAND									
CUP # 4 DRY SOIL									
CUP # 5 MOIST SOIL									

24 A

Draw a line to show how this bird would glide on air currents from A to B.

A

B

Freshly Plowed Field

Stand of Trees

Super Highway

Sandy Beach

Lake

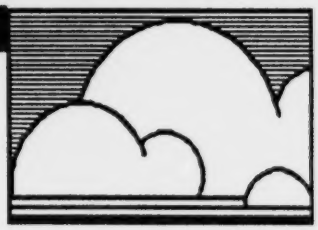
Small Town

25 A

SOARING BIRD

HANDOUT #6

RELATIVE HUMIDITY/CLOUDS STATION - FIRST DAY



OVERVIEW ➡➡➡➡➡➡➡➡➡

Two of the basic concepts of weather will be studied at this station - relative humidity and clouds. For the first day students will concentrate on relative humidity and how it is measured.

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ Questions and Answers sheet for each student (HANDOUT #7)
- ✓ Relative Humidity Chart (p. 338, A FIELD GUIDE TO THE ATMOSPHERE) or program on the WEATHERLINKER disk
- ✓ SCIENCE TOOLKIT
- ✓ 2 thermometers
- ✓ 1 small piece of cotton cloth
- ✓ water
- ✓ large, shiny, tin can
- ✓ ice cubes
- ✓ WEATHERLINKER diskette

DIRECTIONS ➡➡➡➡➡➡➡➡➡

Be sure students have the Questions and Answers sheet (HANDOUT #7) prior to class and be prepared to discuss the information on relative humidity with them. The discussion can end with questions such as the following to test content comprehension:

If air at 5 º C. has the capacity to hold 1000 grams of water vapor and your measurement indicates that there are 1000 grams of water vapor present, what is the relative humidity of that air?

If the temperature of that same air, with no change in water vapor, increases to 10 º C., what will be the new relative humidity?

Divide the students into two groups for the activities.

ACTIVITIES ➡➡➡➡➡➡➡➡➡➡

Measuring Relative Humidity (GROUP 1)

- Place one thermometer outside the window and allow the temperature to stabilize - about two minutes. Record the temperature to the nearest degree.
- Wrap the second thermometer with the small piece of cloth that has been moistened and place it outside the window. Swing the thermometer in the air. Once again allow the temperature to stabilize and record the reading.
- Determine the difference between the two readings. The difference is called the **Wet Bulb Depression.**
- Use the Relative Humidity Chart or the program on the WEATHERLINKER diskette to determine the relative humidity.

1. Find the air temperature or the dry bulb thermometer reading along the left side of the chart (Your first reading.).
2. Find the correct Wet Bulb Depression across the top of the chart (The difference between your two readings.).
3. Where the two lines intersect is the relative humidity.

Measuring Relative Humidity(GROUP 2)

Fill the tin can with water which is at air temperature. Use the thermistor from the SCIENCE TOOLKIT to stir the water and slowly add ice cubes. (The SCIENCE TOOLKIT program should be set to record the changing temperature.) Continue to slowly stir the solution and add ice cubes until the first evidence of moisture can be detected on the exterior of the can. (The can will become slightly dull in color. Do not wait until large droplets form!) At the moment the moisture occurs, the temperature should be read. (Stop the computer recording!) This temperature is the dew point, or the temperature at which moisture in the air begins to condense. Use the program on the WEATHERLINKER diskette to determine the relative humidity from this reading.

ASSIGNMENTS ➡➡➡➡➡➡➡➡➡➡

If time permits, students may use the program on the WEATHERLINKER diskette to experiment with relative humidity using invented data.

Question 1: What determines the three states of water?

Answer: Water is found in three conditions or states: Liquid, solid (ice), or gas (water vapor). The state is determined by both temperature and surrounding pressure (usually air pressure).

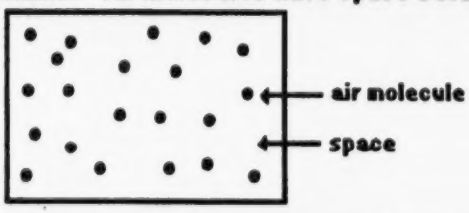
Question 2: How can we describe water vapor or the gaseous state of water in the air?

Answer: Water vapor CANNOT - be seen - be felt - be smelled - be tasted! It is all around us but we cannot directly sense it. There are some indirect indicators of water vapor in the atmosphere:

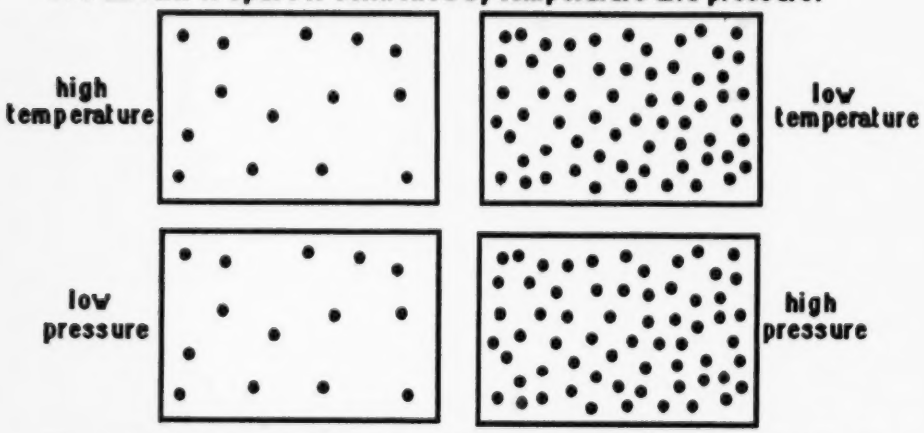
- We are physically uncomfortable when the water vapor is high (muggy, damp, etc.).
- Static electricity is in the air when there is a low amount of water vapor.
- Cold surfaces (drinking glasses) "sweat" in high amounts of water vapor.

Question 3: What is relative humidity?

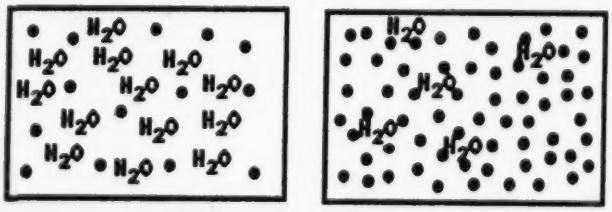
Answer: Relative humidity is only one method of describing "how much water vapor the atmosphere contains." Air molecules have space between them.



The amount of space is controlled by temperature and pressure.



The amount of space determines the number of water vapor molecules that can be present.



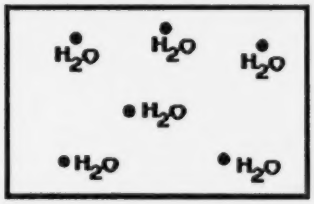
As you can see, the diagram on the left indicates conditions where more water vapor molecules can be present.

28 A

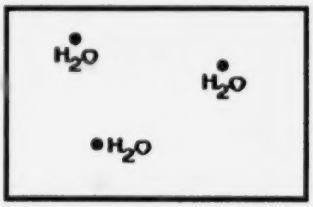
Question 4: How is relative humidity determined? HANDOUT # 7

Answer: Relative humidity is a percentage or ratio of how much water vapor is actually present compared to how much the air could possibly hold at the present temperature and pressure.

This air parcel at 20°C. can possibly hold six water vapor molecules.



However, for some reason (and usually the reason is how much water vapor is available) the air has only three water vapor molecules.



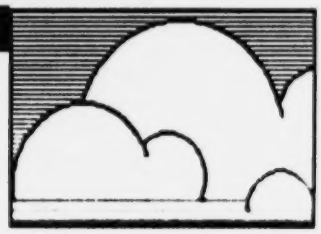
This air actually has 1/2 of the water vapor molecules that it could have at the present temperature. We say that this air has a relative humidity of 1/2 or 50%.

When the air has all the water vapor it can possible hold, the relative humidity is 100%.

Question 5: What happens to relative humidity when the temperature is changed?

Answer: We know that as the temperature is lowered, the space between the molecules will decrease. If the air at 20° C. has enough space for six water vapor molecules then as the temperature changes to 10° C. the amount of space available for water vapor molecules is 1/2 as much or three. That means at 20° C. with three water vapor molecules present, the relative humidity is 50%. With NO CHANGE in water vapor content (3 molecules) and a temperature reduction to 10° C., all available space for water vapor molecules is occupied. The relative humidity is 100%.

RELATIVE HUMIDITY/CLOUDS STATION - SECOND DAY



OVERVIEW ➡➡➡➡➡➡➡➡➡

For the second day in this station, students will study the major cloud types and observe clouds outside the classroom.

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ CASTLES IN THE SKY filmstrip
- ✓ Cloud charts
- ✓ A FIELD GUIDE TO THE ATMOSPHERE
- ✓ Major Cloud Types worksheet (HANDOUT #8)
- ✓ Observing Clouds worksheet (HANDOUT #9)
- ✓ Clear glass jar
- ✓ Hot water
- ✓ Matches
- ✓ Bowl
- ✓ Ice cubes in a small plastic bag
- ✓ WEATHERLINKER diskette

DIRECTIONS ➡➡➡➡➡➡➡➡➡

Students will need as many reference sources as possible to study the major cloud types. Besides the listed materials, try to get others from the school media center.

The "Making a Cloud" activity may be used if students are unable to go outside or if the teacher feels that another activity is necessary.

ACTIVITIES ➡➡➡➡➡➡➡➡➡

<u>Cloud Directory</u>

Distribute Major Cloud Types worksheet (HANDOUT # 8). Students will use the filmstrip, cloud charts, and reference books to draw the major cloud types.

Observing the Clouds

If weather permits, students should go outside the classroom to observe clouds and record the general weather conditions. Distribute the Observing Clouds worksheet (HANDOUT #9) for this activity. If this is not possible, students can do some observation through the classroom windows.

Making a Cloud

- Warm a glass jar by filling it with hot water. Wait for one minute.
- Pour the water from the jar. The air in the jar will be warm and full of water vapor.
- Light a match and drop it into the jar. (The match will go out immediately.)
- Stuff a bag of ice into the top of the jar. Make sure the jar top is completely covered.
- Place the jar into a bowl of hot water.
- You should be able to observe the water vapor inside the jar condensing on the tiny solids formed by the smoke---in other words, you have made a cloud!

ASSIGNMENTS ➡➡➡➡➡➡➡➡➡➡

If time permits, students may use the program on the WEATHERLINKER diskette to experiment with cloud formation levels.

CIRROSTRATUS
CIRRUS
CIRROCUMULUS
STRATUS
STRATOCUMULUS
NIMBOSTRATUS
CUMULUS
ALTOCUMULUS
CUMULONIMBUS

NORTH

SOUTH

EAST

WEST

General Weather Conditions:

WIND STATION - FIRST DAY

OVERVIEW ➡➡➡➡➡➡➡➡➡

Although wind, one of the basic weather concepts, is invisible, it produces effects that are visible and measurable. In this station students will find out how to measure both wind speed and wind direction.

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ Questions and Answers sheet for each student (HANDOUT #10)
- ✓ Clear compass
- ✓ Wind Direction transparency (TRANSPARENCY #2)
- ✓ Materials listed for Wind Station - Second day (see explanation below)

DIRECTIONS ➡➡➡➡➡➡➡➡➡

Review Questions and Answers sheet (HANDOUT #10) and discuss with the group.

Students will probably begin the activities for the second day of this station before the end of first day. All necessary materials should be available.

ACTIVITIES ➡➡➡➡➡➡➡➡➡

Determining Wind Direction

- Place a clear, plastic compass on an overhead projector. Note that the free-floating pointer is in line with the directions, North and South.
- Determine which end points to the north and then rotate the compass until the pointer is in alignment with the "N" on the dial.
- Identify the four cardinal directions on the compass (north, south, east, west).
- Identify the intermediate directions on the compass (northeast, southeast, northwest, southwest).
- Use the Wind Direction transparency (TRANSPARENCY #2) with the compass to practice naming the indicated wind directions.

QUESTIONS AND ANSWERS - WIND **HANDOUT #10**

Question 1: What is wind?

Answer: Wind is air in motion.

Question 2: What causes wind?
Temperature or heat differences between areas. (See questions on temperature.)

Question 3: What causes differences in wind strength?

Answer: The difference in heat from one place to another determines wind strength (Great difference - strong wind / little difference - no wind).

Question 4: What causes differences in wind direction?

Answer: The primary factor in wind direction is the rotation of the earth. Other causes include physical features such as mountain ranges, shorelines, vegetation, and large areas of concrete such as parking lots. The passage of weather fronts is also a contributing factor.

Question 5: Where does wind occur?

Answer: Anywhere in the atmosphere.

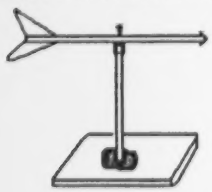
Question 6: Why is wind important?

Answer: Wind affects many of our daily activities -- aviation, sailing, farming, and recreation.

Question 7: How is wind measured?

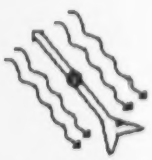
Answer: Two features are considered in the measurement of wind -- direction and speed.

WIND VANE - Measures wind direction



Top View

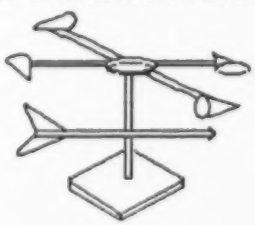
A. EAST



B. NORTHWEST

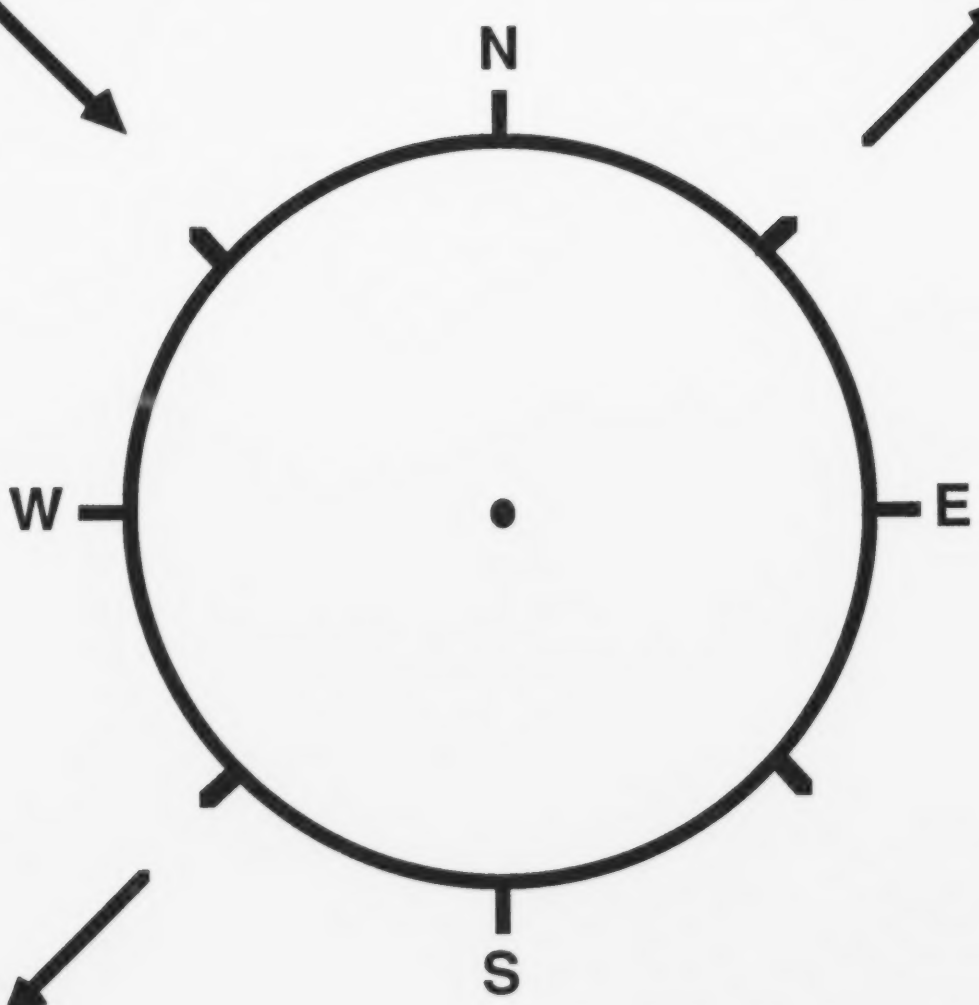
ANEMOSCOPE - Measures wind speed

ANEMOMETER - Measures wind direction and speed



WIND AT TIME A

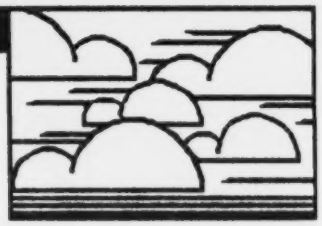
WIND AT TIME B



WIND AT TIME D

WIND AT TIME C

WIND STATION - SECOND DAY



OVERVIEW ➡➡➡➡➡➡➡➡➡

Students will make and use instruments to measure wind speed and wind direction during the second day of this station. Many will have started the construction of these instruments on the first day of the wind station.

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ 3-speed electric fan
- ✓ WEATHERLINKER diskette
- ✓ Determining Wind Speed (HANDOUT #11), optional
- ✓ Directional signs (N-S-E-W), optional

For each two students in GROUP 1:

- ✓ Straight pin
- ✓ Unsharpened pencil
- ✓ Small portion of modeling clay
- ✓ 10" - 12" cardboard square
- ✓ Plastic straw
- ✓ Index cards
- ✓ Scissors
- ✓ Detergent "spout" (optional)

For each two students in GROUP 2:

- ✓ 4 sheets construction paper (1 sheet a different color)
- ✓ Clear tape
- ✓ Scissors
- ✓ Styrofoam ball (2" in diameter)
- ✓ 4 wooden skewers
- ✓ Test tube
- ✓ Sharp instrument
- ✓ Small portion of modeling clay
- ✓ 10" - 12" cardboard square
- ✓ Unsharpened pencil

DIRECTIONS ➡➡➡➡➡➡➡➡➡

Divide the students in this station into two groups with students working in pairs. One group will construct anemoscopes and the other will construct wind vanes.

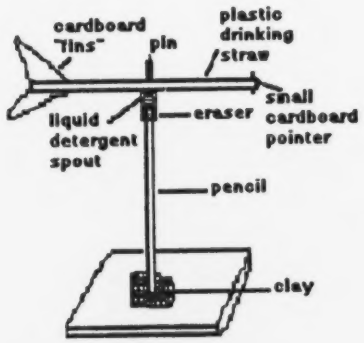
After the instruments are completed, use the electric fan to test them. Directional signs may be placed in the correct locations on walls, windows, etc. and used for wind direction readings as the fan is moved to different areas.

Distribute HANDOUT #11 and have students follow directions to determine wind speed or use the "Wind Speed" program on the WEATHERLINKER diskette.

Students that make wind vanes should also make wind direction readings. These students will probably enjoy using the "Wind Chill" program on the WEATHERLINKER diskette.

ACTIVITIES ➡➡➡➡➡➡➡➡➡➡

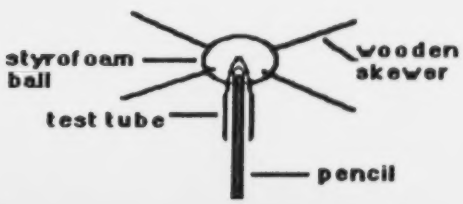
Making a Weather Vane (GROUP 1)

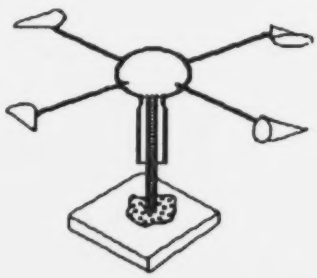


- Split the ends of a plastic straw. Slip a small pointer cut from an index card into one end and index card fins into the other.
- Press a ball of modeling clay onto the center of the cardboard base.
- Insert an unsharpened pencil vertically into the clay.
- Stick a pin through the straw about 1/3 distance from the pointer end and 2/3 distance from the fin end. Then stick the pin into the pencil eraser.
- A liquid detergent "spout" may be used to reduce friction. (See diagram.)

Making an Anemoscope (GROUP 2)

- Use a sharp instrument (a pencil should work) to carve out a hole in a 2" styrofoam ball. The hole should extend to the center of the ball.
- Insert the closed end of a test tube about half way into the hole.
- Assemble three small construction paper cones of one color and one cone of a different color.
- Carefully insert a wooden skewer into each cone as illustrated.
- Insert the other ends of the skewers into the styrofoam ball. The cones should be equal distance from the styrofoam ball.
- Press a ball of modeling clay onto the center of the cardboard base.
- Insert the eraser or unsharpened end of the pencil vertically into the clay.
- Placed the open end of the test tube over the pencil.
- Test the instrument to make sure it can spin freely.





Formula for calculation of wind speed:

circumference x revolutions per minute x .001 = miles per hour

- Measure (inches) the diameter of the anemoscope (Measure from the outside end of one cone to the outside end of the opposite cone.).

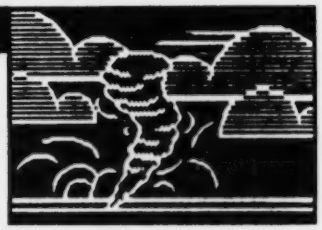
- Multiply the diameter by 3.14 to determine distance of one complete revolution. This is the circumference. Record the circumference on the side of one of your cones.

- Count the number of complete revolutions per minute. The odd colored cone will help with this count.

- Multiply the number of revolutions by 60. This is inches per hour.

- Divide the inches per hour by 63,360. This is miles per hour.

AIR PRESSURE - FIRST DAY



OVERVIEW ➡➡➡➡➡➡➡➡➡

The pressure of the atmosphere is simply a measure of the pressure caused by the mass of the air above us and is one of the basic weather concepts. For the first day of this station, students will become aware of air pressure through a variety of experiments.

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ Questions and Answers sheet (HANDOUT #12)
- ✓ Air Pressure Activities worksheet (HANDOUT #13)

Activitiy One
- ✓ Newspaper
- ✓ Thin stick (paint stir-stick is good)

Activity Two
- ✓ Milk bottle
- ✓ Hard-boiled egg
- ✓ Paper matches
- ✓ Paper

Activity Three
- ✓ 1/2 gal. milk carton
- ✓ Water
- ✓ Scissors
- ✓ Sharpened pencil

DIRECTIONS ➡➡➡➡➡➡➡➡➡

Discuss Questions and Answers sheet (HANDOUT #12) as much as possible during class period.

Students should do as many activities as time allows. They will complete the Air Pressure Activities worksheet (HANDOUT #13) as they work through the activities.

ACTIVITIES ➡➡➡➡➡➡➡➡➡

Activity 1 - Break the Stick

Place a stick about the size and thickness of a paint stir-stick across a table so that it hangs about 10 - 12 cm. over the edge of the table. Open a section of the newspaper and use it to cover the part of the stick that is on the table. Push down slowly on the stick and the pressure of the air can be felt. There will be a lot of resistance, enough to break the stick if it is struck quickly with the hand. This is a bit of a trick due to the momentum of the hand and the inertia of the newspaper. The pressure of the air upon the newspaper and its inertia allows you to break the stick.

Activity 2 - Egg in the Bottle

Peel the hard-boiled egg. Ask one student to be an assistant. Put a piece of burning paper in the bottle. Students should be instructed to watch closely. Immediately after the flame goes out, ask the assistant to place the egg on top of the bottle. Very quickly the egg will be pushed into the bottle. (*The heat from the burning paper causes the molecules of air in the bottle to move faster creating more air pressure inside the bottle. Air is forced from the bottle. The flame goes out and the air begins to cool and contract. Air can no longer pass in and out of the bottle because of the egg. There is less air pressure in the bottle than outside the bottle. Therefore, the air pressure in the room pushes the egg into the bottle.)*

To remove the egg you must first tip the bottle so that the egg is in the neck of the bottle and acts as a stopper. Heat the bottle. The egg should pop out! (Be careful where the bottle is pointed.)

Activity 3 - Milk Carton

Punch two holes in the same side of an empty milk carton, one near the bottom and one near the top. Remove the top part of the carton. Fill the carton with water while holding your fingers over the holes. Remove your fingers and allow the water to flow through the holes. (*The top hole will have very little water flowing out, while the water will flow freely from the bottom hole. The water in the bottom of the carton has more pressure because of the weight of the water above.)*

Question 1: What is the atmosphere?

Answer: The earth is surrounded by a huge sphere of air that stretches from the surface of the earth to the beginning of outer space. This sphere of air is called the atmosphere and is often described as an ocean of air that constantly changes due to currents, waves, and tides. The atmosphere is divided into layers stacked one on top of the other.

Question 2: What is the troposphere?

Answer: The layer of the atmosphere that is closest to the earth's surface is called the troposphere. It is about 8 miles thick and contains nearly 90% of all the moisture and over half of the air in the atmosphere. This is the layer in which nearly all life on the earth exists. Almost all of the weather events that we observe take place in this layer.

Question 3: What is the stratosphere?

Answer: The layer above the troposphere is known as the stratosphere and extends up to an altitude of about 50 miles above the earth's surface. This layer contains a band of ozone which is a form of oxygen that is made up of three oxygen atoms rather than two atoms like the oxygen we normally breathe. Ozone is responsible for filtering out most of the harmful ultraviolet radiation that the sun directs toward the earth.

Question 4: What is the ionosphere?

Answer: The ionosphere rests above the stratosphere. This layer gets its name from the small charged particles that exist there known as "ions." In this layer strong radiation from the sun knocks electrons off oxygen molecules creating ions. These ions are able to reflect radio waves, thereby making it possible for us to conduct long distance broadcasts around the earth. The ionosphere extends up to about 250 miles above the earth.

Question 5: What is the exosphere?

Answer: The exosphere is the beginning of interstellar space.

Question 6: What does the atmosphere do for the earth?

Answer: When compared to the thickness of the earth, the atmosphere is only a thin blanket surrounding the globe. This blanket consists of about 80% nitrogen and 20% oxygen plus a few other traces of gases. The atmosphere protects us from bombardment of meteors and harmful temperature extremes. Without its protection, surface temperatures would reach 200°F. (93°C.) during the day and about -280°F. (-137°C.) at night.

Question 7: How could the atmosphere be described?

Answer: We think of air as being colorless, odorless, and weightless. The first two descriptions are true, but air in the atmosphere does have weight.

Question 8: Why does the atmosphere have weight?

Answer: The atmosphere is held around the earth by the force of gravity. As one approaches the earth from outer space, each layer of the atmosphere is thicker and heavier. All of the air in the atmosphere is stacked above the earth's surface causing a pressure on all objects on or near the earth.

Question 9: How much does the atmosphere weigh?

Answer: About one ton (2,000 lbs.) of air pushes against each square foot of the earth's surface. This is about 14.7 lbs. per square inch.

Question 10: Why doesn't all this weight crush us?

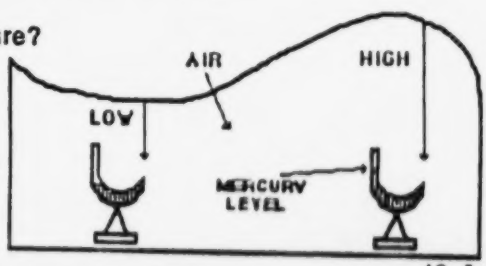
Answer: Fortunately, we are accustomed to this amount of pressure and it is not felt by us. This is due to the fact that the pressure is exerted in all directions in the atmosphere and that it equalizes so that we do not feel pressure from only one direction. Otherwise, we might be flattened like a pancake.

Question 11: How do we measure air pressure?

Answer: A barometric tube of mercury can be used to weigh air. The rising or falling mercury tells us if the air pressure is high or low. The vertical height of the atmosphere behaves like the ocean with crests and troughs. On weather forecasts the barometric pressure is usually given in inches of mercury.

Question 12: Why do we need to measure air pressure?

Answer: Because most storms occur in low pressure areas, a barometer can be a very important instrument. Changes in air pressure may reflect a change in the weather.



43 A

Break the Stick

Describe what happens and tell why you think it happened!

Egg in the Bottle

Describe what happens and tell why you think it happened!

Milk Carton

Describe what happens and tell why you think it happened!

AIR PRESSURE - SECOND DAY

OVERVIEW ➡➡➡➡➡➡➡➡➡

For the second day of the air pressure station, students will make an aneroid barometer in order to measure barometric pressure.

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ Air Pressure Graph worksheet (HANDOUT #14)
- ✓ WEATHERLINKER diskette

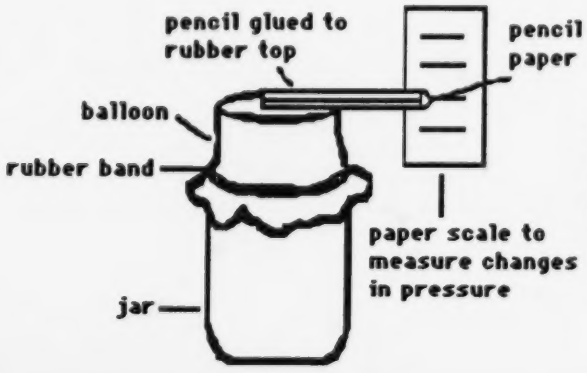
<u>For each two students:</u>

- ✓ Balloon
- ✓ Rubber band
- ✓ Bottle
- ✓ Pencil
- ✓ Paper
- ✓ Glue

DIRECTIONS ➡➡➡➡➡➡➡➡➡

Students work with partners to construct an aneroid barometer. Distribute the Air Pressure Activity Sheet (HANDOUT #14) for students to use for the next four or five days. As students record the barometric pressure from media sources, they should compare it with the readings from their aneroid barometers.

ACTIVITIES ➡➡➡➡➡➡➡➡➡

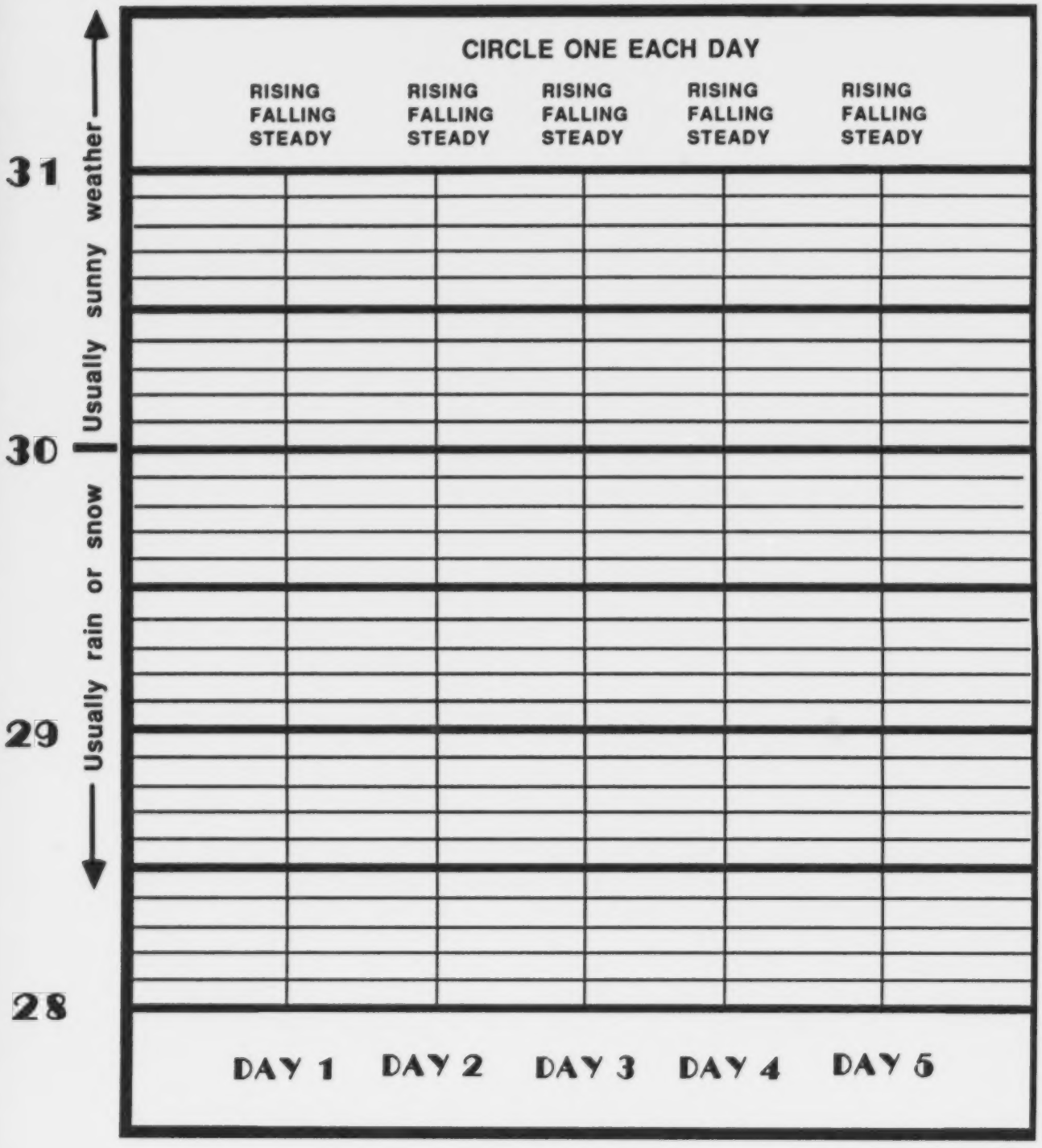


Test the barometer by pressing down on the rubber top. Place the barometer indoors and not in direct sunlight. High pressure outside the jar will make the pencil rise. Low pressure outside the jar will make the pencil fall.

ASSIGNMENTS ➡➡➡➡➡➡➡➡➡

With information from the local weather service, radio, or television station, record the barometric pressure for the next four or five days on the Air Pressure Graph (HANDOUT #14). Compare these readings with the readings from the barometer you have constructed. Consult reference books to analyze the meaning of your measurements. When reporting barometric pressure indicate the pressure in inches of mercury and indicate if the pressure is rising, falling, or holding steady.

If time permits, students may use the program on the WEATHERLINKER diskette to experiment with the relationship between air pressure and altitude.


CIRCLE ONE EACH DAY
RISING
FALLING
STEADY
RISING
FALLING
STEADY
RISING
FALLING
STEADY
RISING
FALLING
STEADY
RISING
FALLING
STEADY
31
30
29
28
Usually sunny weather
Usually rain or snow
DAY 1
DAY 2
DAY 3
DAY 4
DAY 5

WEATHER FORECASTING - FIRST AND SECOND DAYS

OVERVIEW ➡➡➡➡➡➡➡➡➡

Now that students are familiar with the five basic concepts of weather, they are ready for an introduction to weather forecasting. For the first two days of this section, students will learn about weather maps and the special symbols used to indicate atmospheric conditions.

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ WEATHER FORECASTING computer program
- ✓ Large screen monitor for group viewing, optional
- ✓ The Weather Station (HANDOUT #15)

DIRECTIONS ➡➡➡➡➡➡➡➡➡

If a large monitor is available for group computer viewing, students may stay in the same groups as before . If the monitor is not available, students may be divided into smaller groups or partners in order to use the computer. A schedule for using the computer program, WEATHER FORECASTING (three sections in the "Instruction Section"), should be developed before the students begin the activities.

Each student should have a copy of The Weather Station (HANDOUT #15), if possible. However, this activity can be done with partners or small groups working together. (An answer sheet is included for the teacher.)

Introduce The Weather Station (HANDOUT #15) and the computer program, WEATHER FORECASTING, to students. Tell them they will work through these activities for the next two days. Point out the schedule for using the computer and how students will use the schedule to take turns using the computer.

ACTIVITIES ➡➡➡➡➡➡➡➡➡

After an introduction to the handout and computer program, students will work independently for the next two days. Teachers will be available for questions and/or assistance.

The Weather Station

The Weather Station Circle

Weather conditions around the world are observed and shared with other people for the purpose of knowing existing conditions and for predicting future weather conditions. One of the ways this weather information (data) is shared and used is by entering (plotting) the data on a map.

Each weather observing/reporting station in the world is found on some map created especially for the purpose of plotting important weather conditions. The location of each station on the map is indicated by an OPEN CIRCLE with an identifying number or letters under it. For example, Wilmington, North Carolina is shown on a weather map in this manner:

At the same time, everywhere on the earth, weather people observe and report the conditions existing at their location. Interested people take this reported weather and enter it (in a standard form) around and inside a WEATHER STATION CIRCLE.

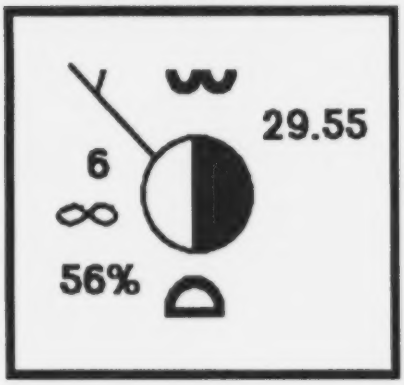
For our activities, the standard form, used throughout the world, has been simplified for ease of use.

ACTIVITY 1

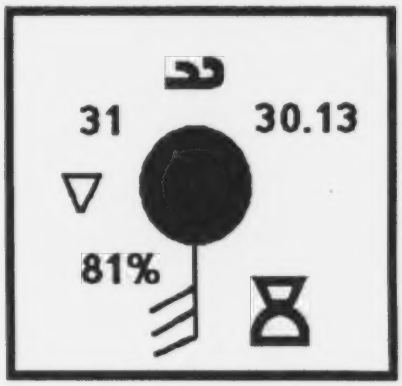
HANDOUT #15

Use the WEATHER STATION CIRCLE Information Sheet to help you answer the questions.

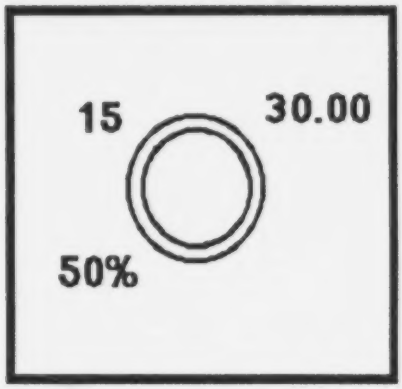
STATION A



STATION B



STATION C



1. At STATION A, the relative humidity is 56%. What is the atmospheric (air) pressure?

   _____

2. The two types of clouds at STATION B are cirrus and _____.

3. The sky is clear of clouds at STATION C and the temperature is

   _____° C.

4. Which STATION is experiencing showers? _____ Haze?_____

5. Which STATION is warmest? _____Its temperature is _____°C.

6. Which STATION is coldest? _____Its wind speed is _____knots.

7. The wind at STATION C is 5 knots 30 knots calm . (circle one)

50 A

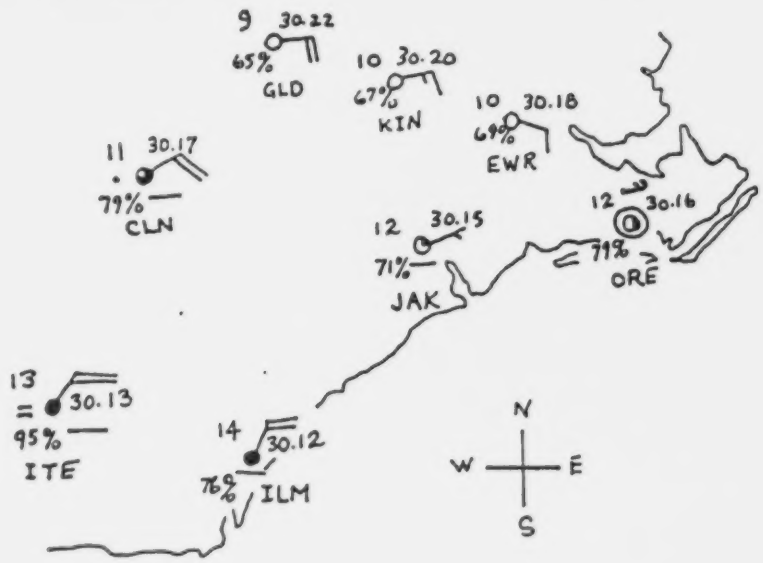
ACTIVITY 2

Use the WEATHER STATION CIRCLE Information Sheet to help you answer the questions.

This is a map of southeastern North Carolina. Weather reporting stations are identified and located as follows:

GLD - Goldsboro
KIN - Kinston
EWB - New Bern
ORE - Morehead City
JAK - Jacksonville
CLN - Clinton
ILM - Wilmington
ITE - (What do you think?)

On this map of weather reporting stations, Morehead City has a temperature of 12°C. and Clinton is reporting stratus clouds.



« What is . . . .

the relative humidity in Goldsboro? _____%

Jacksonville's atmospheric (air) pressure?_____ inches of mercury.

the difference in Kinston's and Wilmington's temperature? _____°C.

« Besides the fog shown at ITE, where is another location where current weather is occuring? _____

What is that weather?_____

« Write the name of the location shown as ITE._____

« The flow of wind over the WESTERNMOST locations is generally from the SOUTHWEST NORTHEAST NORTHWEST SOUTHEAST (circle one)

« Skies are cloudiest in the NORTH SOUTH (circle one)

ACTIVITY 3 (Part 1)

In this activity, you will study a weather system crossing North Carolina from WEST to EAST (This is normally how systems progress.). The first map in the series shows weather conditions at 6AM (0600). Notice that each succeeding map is 6 hours later than the previous one. For example: After 0600, the conditions are given at 12:00 noon (1200).

In this activity you will note the location of the COLD FRONT on each map and look for weather changes that occur at the different locations the front has passed. For example:

At 0600, the COLD FRONT (shown as) is located approximately north/south and to the east of Asheville and to the west of Boone.

1. The driest air is to the west of the COLD FRONT. You can determine that by looking at the relative humidities at Asheville and Boone.

   a. What is the relative humidity in Asheville?_____%
   b. Is the relative humidity in Boone HIGHER/LOWER than Asheville's? _____
   c. Is the driest air associated with the HIGHEST/LOWEST relative humidity? _____

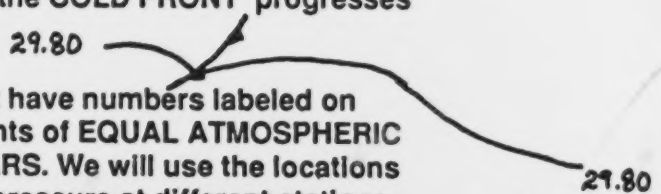
2. Which location is in the COLD AIR? Asheville or Boone? _____

3. The WARM AIR is associated with what wind direction? northwest or southwest? _____

Other things to look at that are important around a COLD FRONT are:

Atmospheric (air) Pressure	Sky Cover
Current Weather	Cloud Type
Wind Speed	

Study the differences between Asheville and Boone. These are the weather conditions that you will notice as the COLD FRONT progresses to the East.



You will also notice lines on the maps that have numbers labeled on each end. These are lines connecting points of EQUAL ATMOSPHERIC PRESSURE. These lines are called ISOBARS. We will use the locations of the ISOBARS to compare atmospheric pressure at different stations.

52 A

Activity 3 (Part 2)

HANDOUT #15

Look at the 1200 (12:00 noon) map.

The COLD FRONT has progressed eastward until it is now located very near Winston-Salem and Charlotte. The WIND DIRECTION and TEMPERATURE shows Winston-Salem to be to the west of the COLD FRONT and in the cold air.

4. **Comparing the Winston-Salem weather at 0600 and 1200, another indication that the COLD FRONT has passed Winston-Salem is the:**

   a. **WIND DIRECTION has gone from _____ to _____.**
   b. **TEMPERATURE has gone from _____°C. to _____°C.**

COLD AIR is always to the WEST/EAST of a COLD FRONT. (circle one)

5. **Identify the following changes in Charlotte's weather between 0600 and 1200:**

   a. **Sky Cover 0600_____ 1200 _____**
   b. **Cloud Type 0600_____ 1200_____**
   c. **Current Weather 0600 _____1200 _____**
   d. **Wind Speed 0600 _____ 1200 _____**

Has the COLD FRONT passed Charlotte on the 1200 map? _____

6. **At sometime between 0600 and 1200, the COLD FRONT went past Boone. You can determine this because:**

   a. **The temperature went from _____ to _____.**
   b. **The Atmospheric pressure changed from ____to_____.**
   c. **The sky cover changed from _____to _____.**
   d. **The relative humidity lowered from _____to _____.**
   e. **The wind direction was _____at 0600 and is _____ at 1200.**
   f. **The wind speed at 0600 was _____ and became _____at 1200.**

7. **Which part of the COLD FRONT moved eastward faster ? northern or southern? _____**

Activity 3 (Part 3)

What you know so far:

- weather systems move toward the east
- air is colder and drier to the west (behind) a cold front
- atmospheric pressure rises when a cold front passes
- wind shifts from the southwest to the northwest with a passing cold front
- skies generally clear up in the cold air behind a cold front
- stormy weather is to the east or ahead of a cold front
- cumulonimbus are near (and usually ahead of) a cold front

Using all the knowledge you have gained to this point, look at the weather occuring in Charlotte at 1200. Consider what will likely happen in the next 6 hours (by 6 PM - 1800). DO NOT LOOK AT THE 1800 MAP!!

Draw and label the conditions you predict will be on the 1800 map at Charlotte. (Finish incomplete entries such as wind speed, etc.)

Do not be confused that the wind direction at Charlotte is not from the northwest as it was in Winston-Salem. The general rule for wind direction when a cold front passes a location is: Wind direction to the east of a cold front is SOUTHERLY (southwest through southeast) and behind the cold front (to the west) is NORTHERLY (northeast through northwest).

NOW LOOK AT THE 1800 MAP. . . .

Were you a good forecaster?

On the 1800 map, notice that WIND DIRECTIONS are almost parallel to the ISOBARS. This is a good general rule.

Activity 3 (Part 4)

HANDOUT #15

Comparing the location of the COLD FRONT at 0600, 1200, and 1800, you will notice that the northern end of the front has moved eastward at a greater speed than the southern end. This is not always the case, but for this activity remember this fact!

8. At 1800, what location is closest to the cold front and still in the warm air?

_____

DO NOT LOOK AT THE 2400 MAP TO ANSWER QUESTIONS 9 - 11.

9. Do you think that the cold front will pass this location by the 2400 (midnight) map? _____

10. What do you predict the wind direction will be in Laurinburg on the 2400 map? _____

11. Wind speed normally increases as a cold front gets closer. What would be a reasonable prediction or FORECAST of wind speed in Greenville at 2400? _____

Now look at the 2400 map and study the weather in Asheville, Charlotte and Laurinburg. If you are alert, you will see that a new type of weather front has appeared. A WARM FRONT is coming into the picture. This type of front has certain differences in weather, wind and clouds from those of a cold front.

12. What type of weather appears in the cold air and near the warm front? _____

13. The cloud type at Charlotte is _____ and that is different than the _____ cloud type found at Elizabeth City.

Activity 3 (Part 5)

By now, you may have a "feel" for predicting future weather based upon trends from the past. Without looking ahead to the final map (a second day at 0600), do your best to forecast weather elements at the following specific locations.

My forecast for the 0600 time at the following locations is:

Raleigh
Cloud Cover 0 1/4 1/2 3/4 overcast (circle one)
Temperature _____
Atmospheric Pressure _____

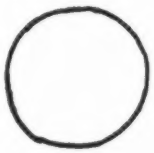
Greenville
Relative Humidity _____
Wind Direction _____
Current Weather none rain showers (circle one)

Elizabeth City
Wind Speed _____
Wind Direction _____
Temperature _____

Hatteras
Cloud Cover 0 1/4 1/2 3/4 overcast (circle one)
Relative Humidity _____
Current Weather none rain showers (circle one)

This one may be difficult, but give it a try:

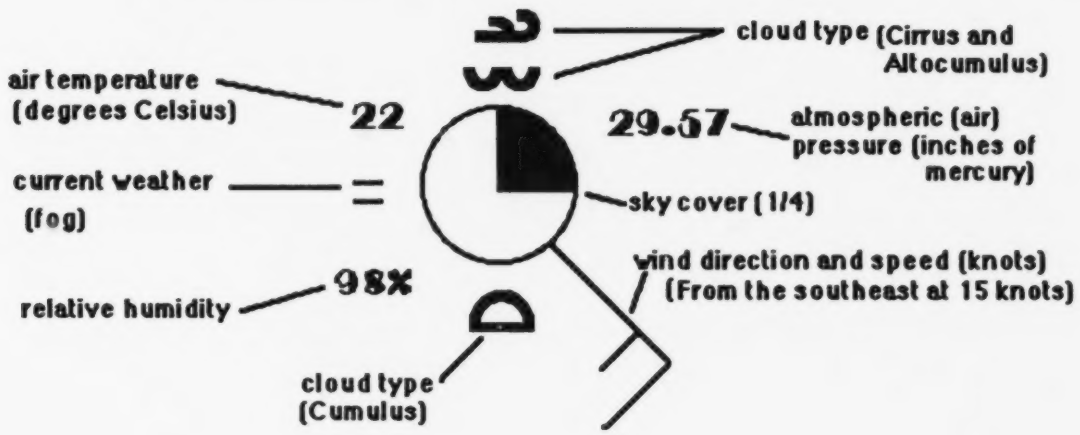
Asheville Complete the station circle:



After completing this page, check your forecasts by looking at the second day 0600 map. Discuss any major differences with your teacher and other members of your class.

WEATHER STATION CIRCLE

HANDOUT #15



WIND

Wind direction is given FROM WHICH it is blowing. For example:

The wind is blowing from the North.

Wind speed is given in knots (nautical miles per hour). It is shown by lines added to the direction indicator. Each long line equals 10 knots. Each short line equals 5 knots. For example:

The speed here is 25 knots with a direction of South.

A circle drawn around the Station Circle indicates Calm (no wind). For example:

CURRENT WEATHER

- Rain
- Snow
- Showers
- Fog
- Haze
- Thunderstorm
- Tornado

NOTE: No symbol in this location means that no restrictions to visibility exist at that time.

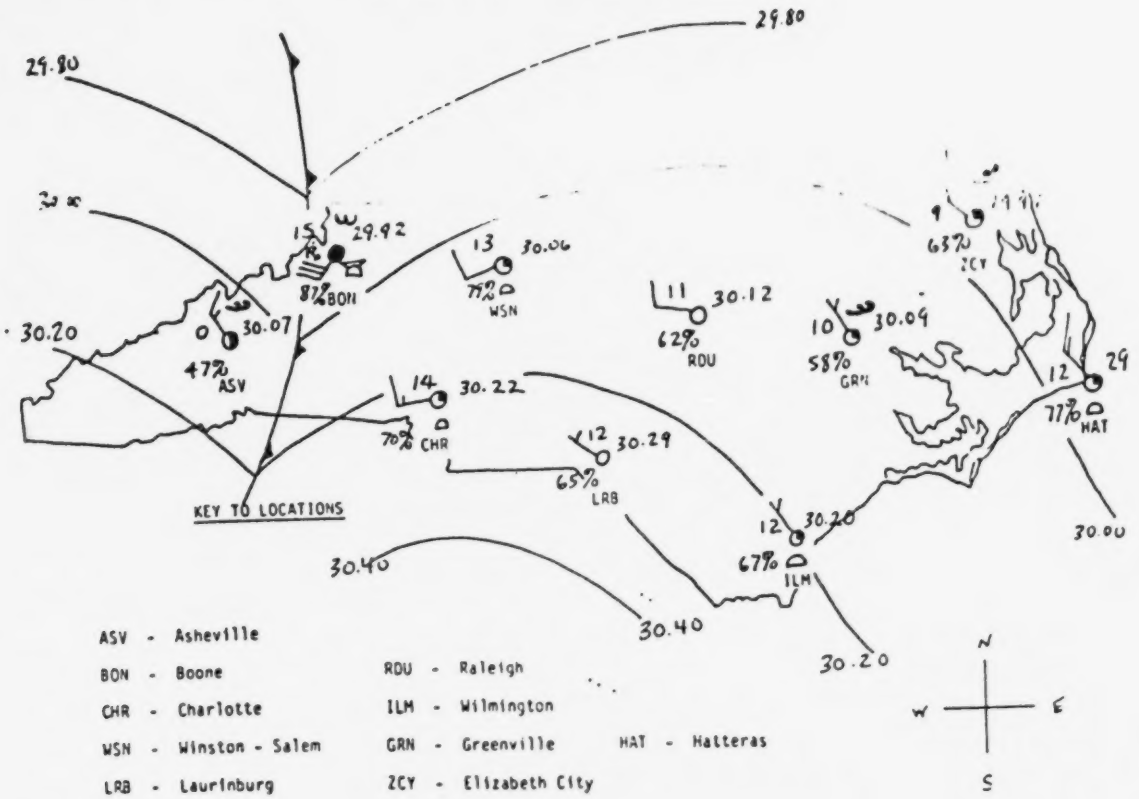
For this model current weather is considered those conditions that restrict how far you can see. (Only reported when visibility is less than 7 miles.)

CLOUDS/SKY COVER

- Cumulus
- Stratus
- Cumulonimbus
- Altocumulus
- Cirrus

- Clear
- 1/4 cover
- 1/2 cover
- 3/4 cover
- Overcast

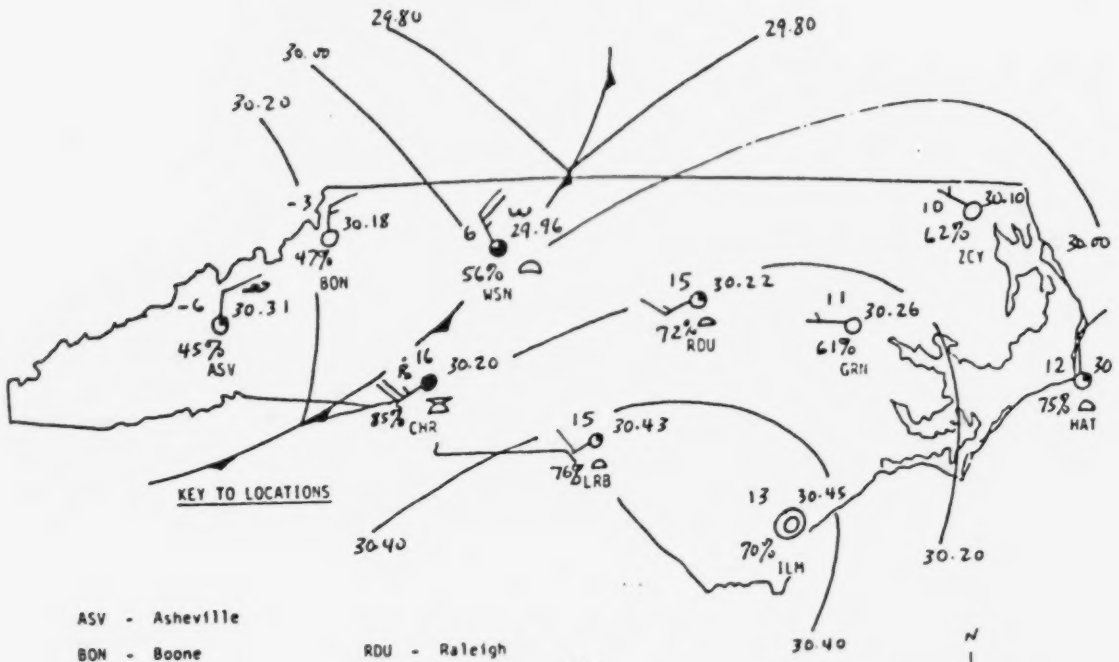
TIME : 0600 (6 AM)



ASV - Asheville
BON - Boone
CHR - Charlotte
WSN - Winston - Salem
LRB - Laurinburg
RDU - Raleigh
ILM - Wilmington
GRN - Greenville
ZCY - Elizabeth City
HAT - Hatteras

N W E S

TIME : 1200 (12 NOON)



ASV - Asheville
BON - Boone
CHR - Charlotte
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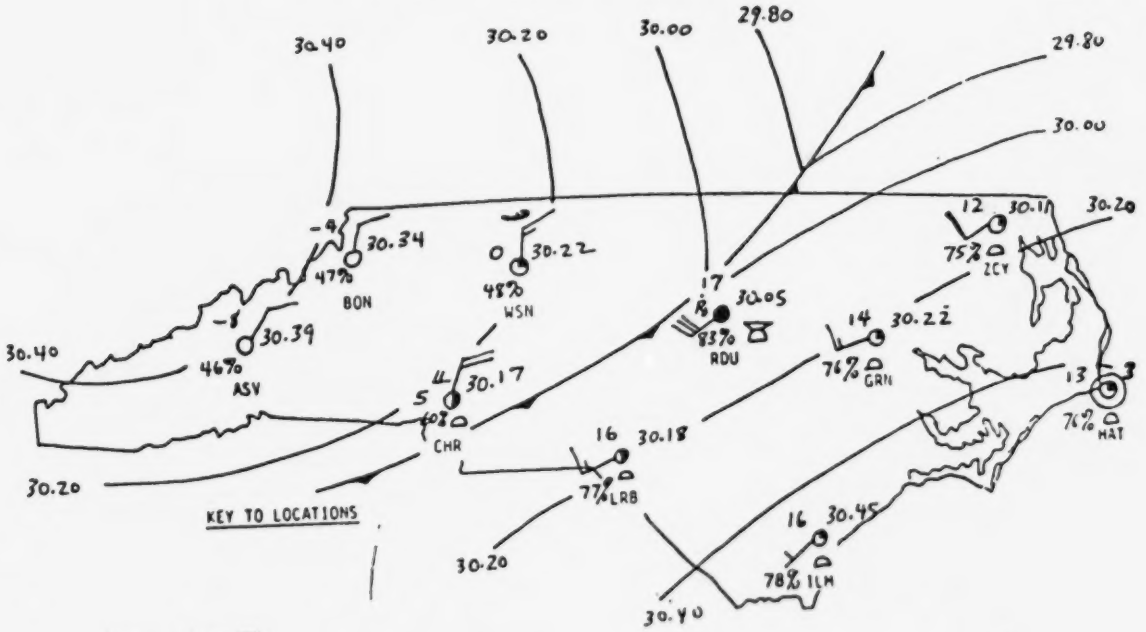
LRB - Laurinburg
RDU - Raleigh
ILM - Wilmington
GRN - Greenville
ZCY - Elizabeth City
HAT - Hatteras

N W E S

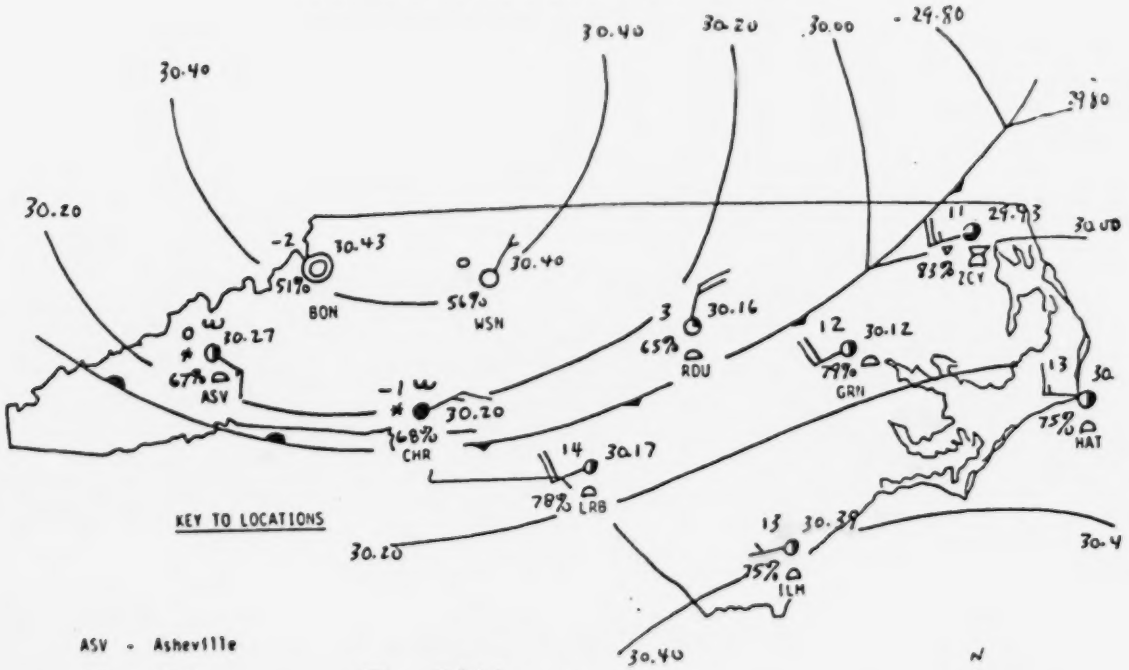
58 A

TIME : 1800 (6 PM)



ASV - Asheville
BON - Boone
CHR - Charlotte
WSN - Winston - Salem
LRB - Laurinburg
RDU - Raleigh
ILM - Wilmington
GRN - Greenville
ZCY - Elizabeth City
HAT - Hatteras

TIME : 2400 (12 MIDNIGHT)



ASV - Asheville
BON - Boone
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ILM - Wilmington
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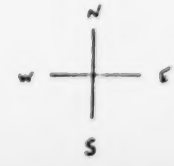
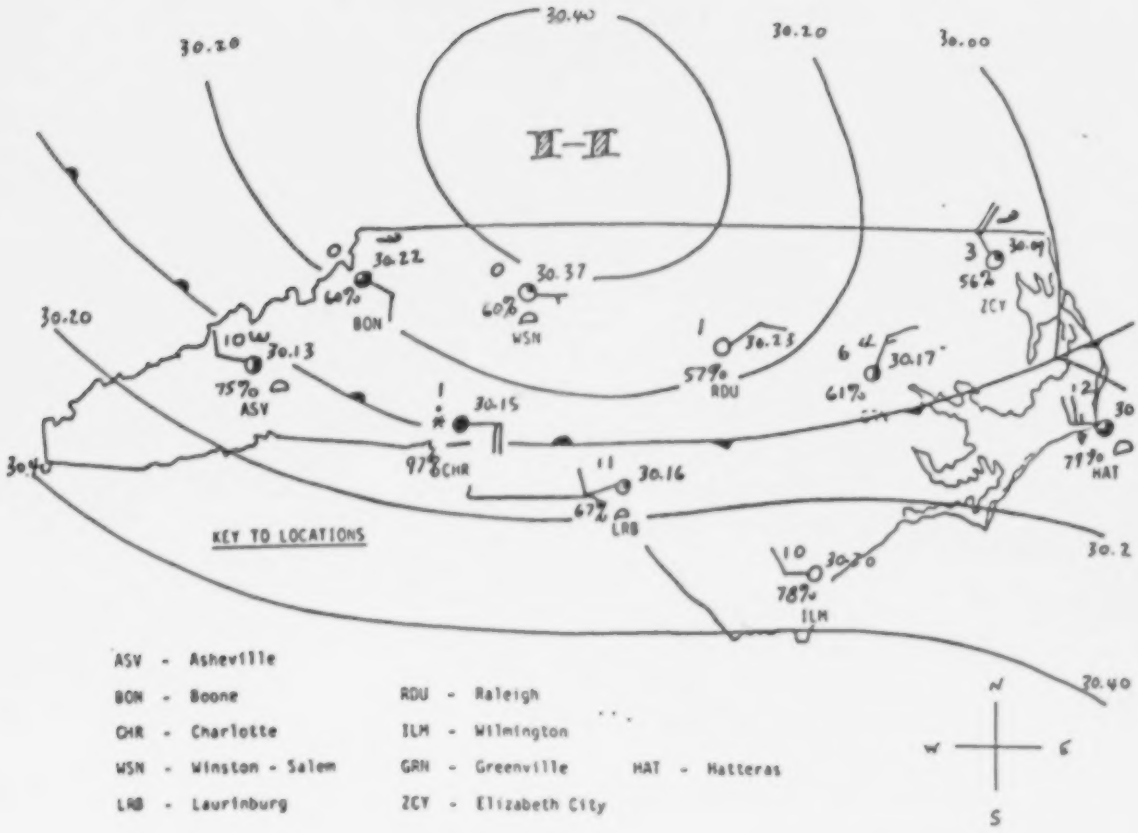
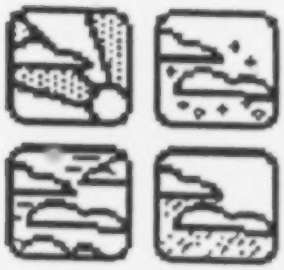


59 A

TIME : 0600 (6 AM) Second Day

HANDOUT #15





ANSWER SHEET for The Weather Station

Activity 1

1. 29.55 inches of mercury
2. towering cumulus
3. 15
4. B and A
5. B, 31°C.
6. A, 5
7. calm

Activity 2

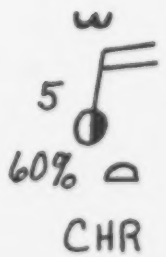
65%
30.14
4
Clinton
Rain
Whiteville
NORTHEAST
SOUTH

Activity 3

1. a. 47 b. HIGHER c. LOWEST
2. Asheville
3. Southwest
4. a. southwest, northwest
   b. 13, 6
   c. WEST
5. a 0600-1/4, 1200-overcast
   b. 0600-cumulus, 1200-towering cumulus
   c. 0600-none, 1200-thunderstorm
   d. 0600-15 knots, 1200-25 knots
   NO
6. a. 15°C. to -3°C.
   b. 29.92 inches of mercury to 30.18 inches of mercury
   c. overcast to clear
   d. 87% to 47%
   e. southwest and is north
   f. 30 knots and became 15 knots
7. NORTHERN

Completed CHR map for 1800

Cloud types can be predicted by looking to stations FROM WHICH air is flowing. (WSN 1200)



Temperatures between 10 and 0 are reasonable

Relative humidities between 45% and 65% are reasonable

Any speed between 10 and 25 knots would be reasonable

Little or no weather will occur shortly after a cold front passes.

8. Raleigh
9. yes
10. southwest
11. 20 to 30 knots
12. snow
13. stratus, cumulonimbus

Raleigh - 0, 1°C. , 30.23 inches of mercury

Greenville - 61%, northeast, none

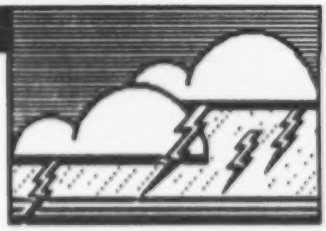
Elizabeth City - 20 knots, northwest, 3°C.

Hatteras - 3/4, 79%, showers

Asheville - See 0600 (second day) map

For the station forecasts, being close is good. A poor forecast would be thunderstorms for Raleigh and a wind direction of east for Greenville.

WEATHER FORECASTING - DATA COLLECTION AND TELECOMMUNICTIONS -- FIVE DAYS



OVERVIEW ➡➡➡➡➡➡➡➡➡

For the next five days, students will collect data and exchange this information with other school sites through telecommunications. All data will be organized, analyzed, and reported.

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ 5 copies of Weather Plotting Map (HANDOUT #16) for each student
- ✓ 5 copies of Daily Weather Forecast (HANDOUT #3) for each student
- ✓ 4 large classroom weather plotting maps
- ✓ 5 large classroom weather station circles
- ✓ North Carolina Transportation Maps
- ✓ word processing program
- ✓ data diskette
- ✓ telecommunications program
- ✓ WEATHERLINKER diskette

DIRECTIONS ➡➡➡➡➡➡➡➡➡

For the next five days students will be involved in actual, on-site weather data gathering, reporting, and interpreting. Weather Circles will be prepared each day using information recorded on the Daily Weather Forecast worksheets (HANDOUT #3). Weather maps (HANDOUT #16) will be prepared during class on DAY 2-5 from local data and the data collected from other participating sites. All schools participating in the WEATHERLINKER Project should be indicated on the maps. These sites can be located by the teacher before duplicating the maps or by students as a class activity on DAY 1.

Divide the class into six teams, each team is assigned to collected one specific type of weather data (temperature, relative humidity, barometric pressure, precipitation, winds, cloud cover). Each day, as the data is collected, one member from each team will record the data on a large classroom weather station circle, with time and date included. As the circles are completed, students will transfer the collected weather data to their individual Daily Weather Forecast worksheets, Sections A and B.

Each student will complete Section C on their own individual Daily Weather Forecast worksheet. Section D of the Daily Weather Forecast will be completed by using data reported during class the following day or from the local weather telecast.

A representative from each team will help enter the collected data into the computer for telecommunications and save it for uploading at the end of the day. It is suggested that the file be prepared in advance with students only adding the collected data. THE SPECIFIED FILE FORMAT MUST BE USED. This file format can be found in the Telecommunications Section following the Teacher's Guide and Student Handouts. Entering data while online would not be a wise use of resources because of long distance telephone charges. ONLY ONE DATA COLLECTION PERIOD WILL BE TELECOMMUNICATED, although the students may collect data at several times during the day. (The teacher will coordinate the collecting time with other teachers involved in the WEATHERLINKER Project.)

Each morning on DAYS 2-5, team representatives will download and print weather data from all reporting sites. This data will be entered by the students on the large Classroom Weather Plotting Map, including date and time. The weather circle format should be used to indicate the information. A local weather circle should be included indicating the previous day's weather data. Students will complete their individual weather plotting maps from the classroom map.

Lead the class in a discussion of what the forecasts might be for the following day and compare the forecasts for the previous day with the collected data. Students will use this time to compare Sections C and D of their individual Daily Weather Forecast worksheets.

NOTE: Although the students may collect local weather data each of the five days, they will collect downloaded data only on DAYS 2-5. They will not upload data on DAY 5.

ACTIVITIES ➡➡➡➡➡➡➡➡➡➡

Students will collect weather data and make recordings. This information will be entered into a data file using a word processing program and saved until the end of the day when it will be uploaded into the FrEdMailer Telecommunications Network. Each morning weather data will be collected and recorded from other schools participating in the WEATHERLINKER Project by downloading the information from the FrEdMailer Telecommunications Network.

After the first day of collecting and plotting data, students should use completed maps to interpret and determine changes in weather conditions across the state.

ASSIGNMENTS ➡➡➡➡➡➡➡➡➡➡

Students should complete Sections C and D of their Daily Weather Forecast worksheet (HANDOUT #3).

If time permits, students may enjoy using the program on the WEATHERLINKER diskette to forecast weather conditions.

Weather Plotting Map

WEATHER PLOTTING MAP

HANDOUT #16

66 A

HANDOUT #3

Daily Weather Forecast

NAME: _____ SCHOOL: _____

GROUP/CLASS: _____ TEACHER: _____

DATE: _____

A.

Time _____

Temp. _____

Relative Humidity _____ %

Barometric Pressure _____ in.

_____ rising _____ steady _____ falling (check one)

Precipitation

Type _____ Amount _____ in.

Winds

Speed _____ m.p.h.

Direction _____

B.

Cloud Cover (check one)

____ clear ____ 3/4 cover

____ 1/4 cover ____ overcast

____ 1/2 cover

Types of Clouds _____

Drawing below of major cloud formations:

C. Forecast for Tomorrow

Skies

_____ clear

_____ partly cloudy

_____ cloudy

Precipitation

_____ yes _____ no _____ maybe

Type predicted _____

Temp. _____ C° high _____ C° low

Wind _____ speed _____ direction _____ shifts

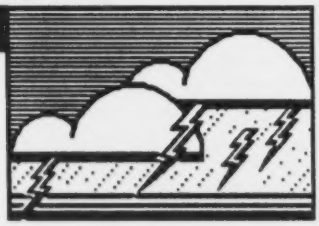
Relative Humidity _____ %

D. Accuracy of Prediction

for _____ (date)

Reported	Correct (check)
Skies _____	_____
Precipitation _____	_____
Temperature	
High _____ C°	_____
Low _____ C°	_____
Wind _____ m.p.h.	_____
_____ direction	_____
Humidity _____ %	_____

WEATHER FORECASTING - FINAL DAY



OVERVIEW ➡➡➡➡➡➡➡➡➡

This will be the final day of weather forecasting. Students will be given the site for the survival scenario and will develop their forecasts based on telecommunicated weather data.

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ Scenario from Day 1 (HANDOUT #1)
- ✓ Survival Weekend map (HANDOUT #17)
- ✓ Weather Maps (HANDOUT #18), optional
- ✓ Colored pencils, optional
- ✓ Word processing program, optional

DIRECTIONS ➡➡➡➡➡➡➡➡➡

If students seem to have problems with tracking weather conditions, (HANDOUT #18) may be used as an optional activity. Lead students to note the various information shown on the maps. The sequence and direction of movements for highs, lows, and fronts should be followed from one map to the other. Colored pencils could be used to highlight fronts, precipitation, etc., from map to map. For example, on the first map, snow flurries are over the extreme Northeast. On the second map, snow flurries are still seen over a small portion of the Northeast. These two flurry areas are the same system and should be colored the same color.

Students may be divided into small groups for the Survival Weekend Adventure activity or they may work alone. Distribute HANDOUT #17 and reveal the site for the survival weekend for which the students are to develop a forecast. The forecast will be based on the weather data that has been collected from all sites across the state. It is suggested that the teacher choose a site that is not near the home school. (Although selected parks have been indicated on the map, other sites may be added by the teacher.)

ACTIVITIES ➡➡➡➡➡➡➡➡➡

Survival Weekend Adventure

Students will reread or listen to the survival scenario used at the beginning of the weather study. Students will locate their assigned site on their Survival Map. Each group will be allowed to consult weather data that has been gathered throughout the weather study in order to

- prepare a forecast of the weather conditions for the weekend
- prepare a weather station circle for the selected site

Forecasts may be prepared and presented as a radio report (tape); a TV report (video); or a newspaper report (printed).

If possible, a word processing program should be available for student use in preparing their forecasts.

ASSIGNMENTS ➡➡➡➡➡➡➡➡➡

Students will probably need to finish their weather forecasts at home.

At the end of your study of weather, you will furnish important information for a team of students who will be taking part in a survival weekend adventure. At present, no one is at liberty to disclose to you the exact location at which the event will be held. However, the adventure will take place in North Carolina. In order for the team to make good decisions as to clothing, food, and shelter that will be needed, it will be necessary for them to have weather information for the weekend. You will prepare a weather forecast for the team based on your study of local and state-wide weather conditions. This information will include: predicted temperatures, cloud cover, precipitation, wind speed and direction, relative humidity, and air pressure.

SURVIVAL WEEKEND

Hanging Rock State Park
Stone Mt. State Park
Medoc Mt. State Park
Merchant's Millpond State Park
Mt. Mitchell State Park
Joyce Kilmer Memorial Forest
Crowder's Mt. State Park
Morrow Mt. State Park
Umstead State Park
Cliffs of the Neuse State Park
Singletary State Park
Ft. Macon State Park

SURVIVAL WEEKEND MAP

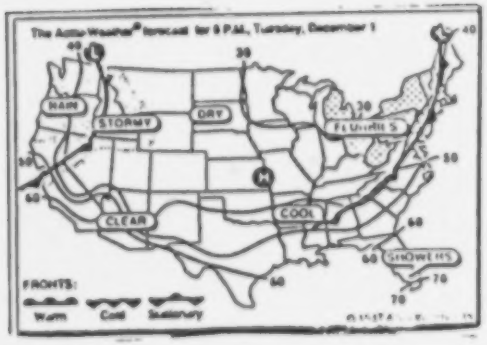
HANDOUT #17

71 A

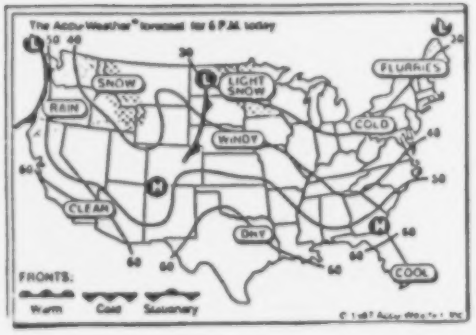
WEATHER MAPS

HANDOUT #18

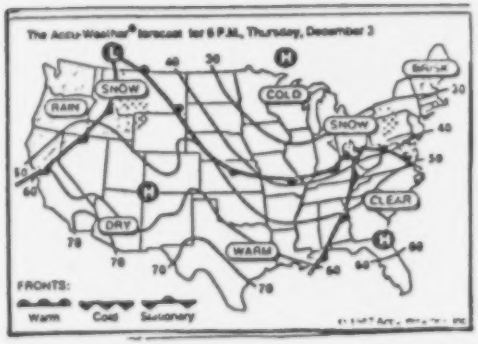
Day 1



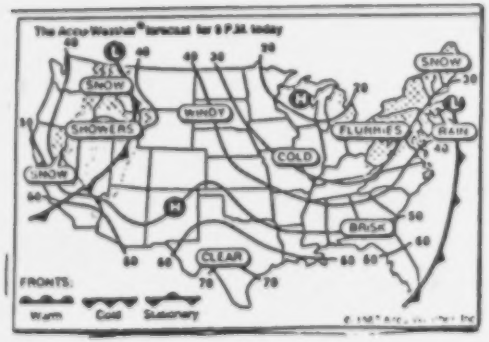
Day 2



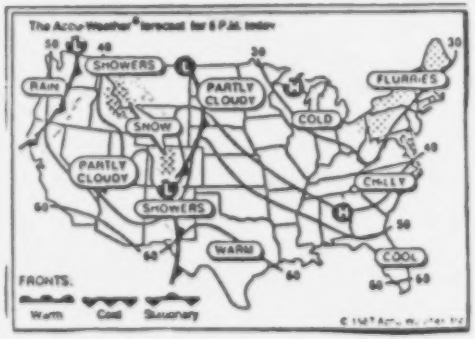
Day 3



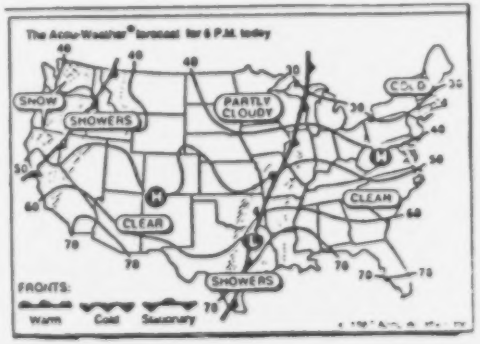
Day 4



Day 5



Day 6

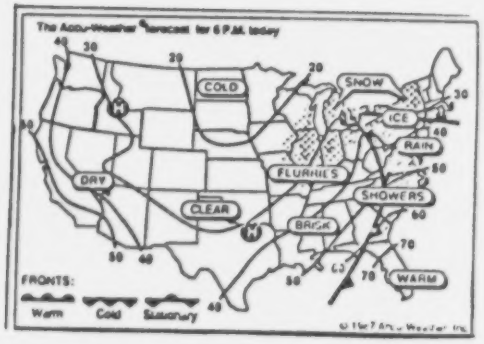


72 A

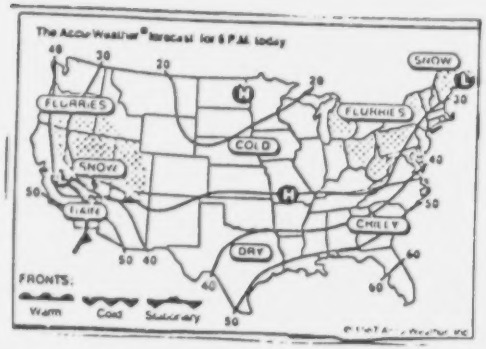
83

84

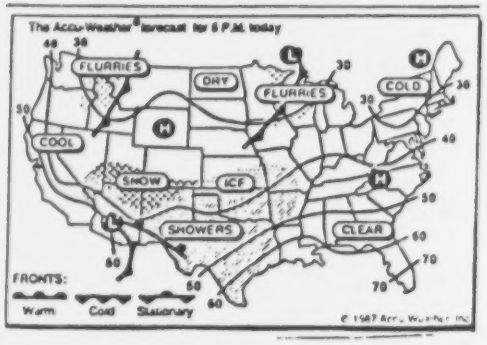
Day 7



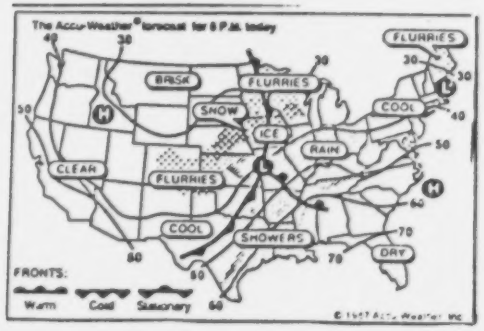
Day 8



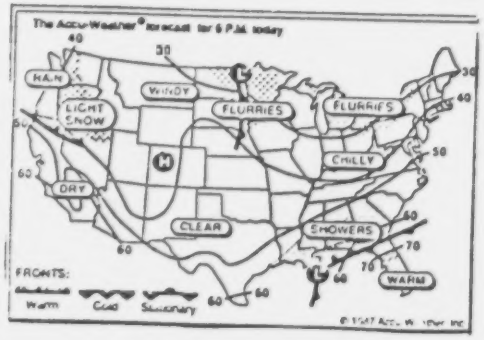
Day 9



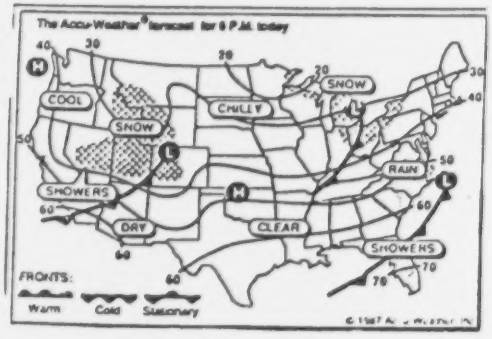
Day 10



Day 11



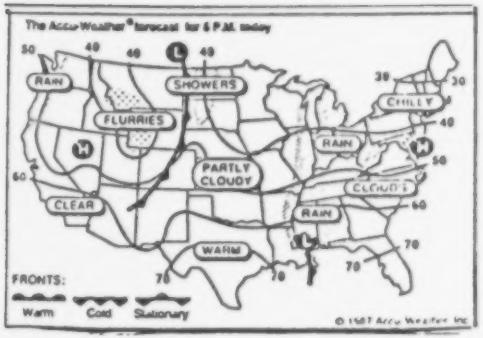
Day 12



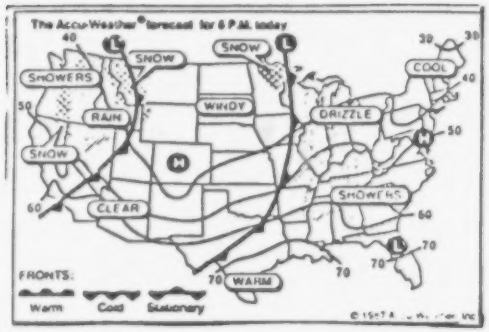
73 A

HANDOUT #18

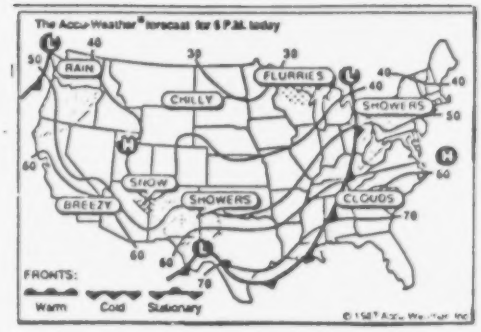
Day 13



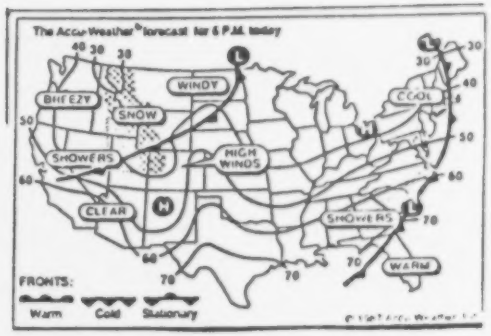
Day 14



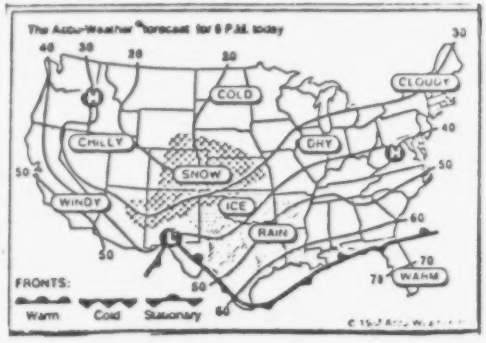
Day 15



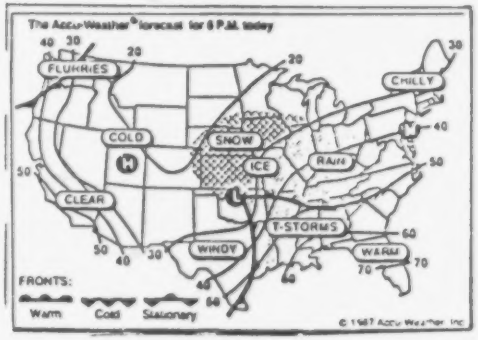
Day 16



Day 17



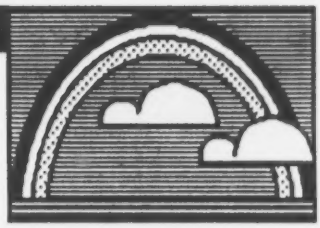
Day 18



74 A

HANDOUT #18

EVALUATION



OVERVIEW ➡➡➡➡➡➡➡➡➡

This day will be devoted to discussing the basic weather concepts, forecasting, and the Survival Weekend Adventure. It will be a time for reviewing the weather project.

YOU WILL NEED ➡➡➡➡➡➡➡➡➡

- ✓ WEATHER FORECASTING computer program, optional
- ✓ Large monitor for class viewing, optional
- ✓ WEATHERLINKER video, optional

DIRECTIONS ➡➡➡➡➡➡➡➡➡

The beginning of this class period should be devoted to a discussion of the Survival Weekend Adventure forecast. Students should be given an opportunity to share their forecasts with the class.

If time permits, the evaluation sections of the computer program, WEATHER FORECASTING, can be used by the class for review.

Students may enjoy viewing the video shown during the introduction to WEATHERLINKER again. Since many of the terms were unfamiliar at the beginning of the study, it would be interesting to see how much information the class has gained during the project.

ACTIVITIES ➡➡➡➡➡➡➡➡➡

Prepared weather forecasts for the Survival Weekend are shared.

View the WEATHERLINKER video and discuss the terms and information gained during the project.

Science notebooks/folders should be completed and checked by the teacher.

STUDENT HANDOUTS

SECTION B

At the end of your study of weather, you will furnish important information for a team of students who will be taking part in a survival weekend adventure. At present, no one is at liberty to disclose to you the exact location at which the event will be held. However, the adventure will take place in North Carolina. In order for the team to make good decisions as to clothing, food, and shelter that will be needed, it will be necessary for them to have weather information for the weekend. You will prepare a weather forecast for the team based on your study of local and state-wide weather conditions. This information will include: predicted temperatures, cloud cover, precipitation, wind speed and direction, relative humidity, and air pressure.

QUESTIONS AND ANSWERS - INTRODUCTION TO WEATHER HANDOUT # 2

Question 1: What is weather?

Answer: Weather is the condition of the atmosphere, e.g., fog is minute particles of water or ice hanging in suspension in the air.

Question 2: In what part of the atmosphere does weather occur?

Answer: Weather, as we experience it, generally occurs within the lowest forty thousand feet of the atmosphere.

Question 3: What are some ways in which weather can affect our daily lives?

Answer: Recreation; travel; clothing; sports; agriculture; outdoor jobs such as construction, fishing, etc.

Question 4: What types of violent or hazardous weather conditions may affect people in North Carolina?

Answer: Coastal: Hurricanes and nor'easters
Piedmont: Tornadoes and severe droughts
Mountain: Heavy snows and ice storms

Question 5: What are some factors that make weather forecasting difficult in North Carolina?

Answer:

- The Gulf Stream modifies air temperatures and alters weather system movement.
- Geographic features (mountains, flatlands, and coastal environment) strongly modify passing air masses.
- The latitude in which North Carolina is situated is in the direct path of major storm systems, particularly in winter. The location is where upper atmospheric flow patterns characteristically shift toward a northeast direction. Surface weather systems are redirected toward the northeast and over the ocean.

Question 6: What are the components of weather that change daily?

Answer: clouds (amount, type, height)
precipitation (amount, type, intensity)
temperature
moisture content (water vapor)
wind (direction, speed)
atmospheric pressure (weight)
restrictions to visibility (smoke,smog, dust,salt, fog, haze)
hazardous/unhealthy conditions (pollen, acid rain)

HANDOUT #3

Daily Weather Forecast

NAME: _____ SCHOOL: _____

GROUP/CLASS: _____ TEACHER: _____

DATE: _____

A.

Time _____

Temp. _____

Relative Humidity _____ %

Barometric Pressure _____ in.

_____ rising _____ steady _____ falling (check one)

Precipitation

Type _____ Amount _____ in.

Winds

Speed _____ m.p.h.

Direction _____

B.

Cloud Cover (check one)

____ clear ____ 3/4 cover

____ 1/4 cover ____ overcast

____ 1/2 cover

Types of Clouds _____

Drawing below of major cloud formations:

C. Forecast for Tomorrow

Skies

_____ clear

_____ partly cloudy

_____ cloudy

Precipitation

_____ yes _____ no _____ maybe

Type predicted _____

Temp. _____ high C° _____ low C°

Wind _____ speed _____ direction _____ shifts

Relative Humidity _____ %

D. Accuracy of Prediction

for _____ (date)

Reported	Correct (check)
Skies _____	_____
Precipitation _____	_____
Temperature	
High _____ C°	_____
Low _____ C°	_____
Wind _____ m.p.h.	_____
_____ direction	_____
Humidity _____ %	_____

Question 1: What is air temperature?

Answer: Air temperature is the measure of heat or radiant energy from the sun that is released into the atmosphere by surfaces or substances on earth and is transferred to air molecules.

Question 2: Why is air (atmospheric) temperature important to know?

Answer: Air temperature affects the density (weight) of air as well as the amount of water vapor that can be held (suspended) in a given amount of air. As air is heated it expands and fewer molecules are in the same space. The heated air is less dense and therefore rises. Cooler air is more dense and therefore falls. This rising and falling of air causes circulation patterns to be established that results in the formation of winds and the movement of air masses across the earth.

Question 3: What factors affect air temperature?

Answer:

- The uneven heating of surfaces on earth affect air temperature. Dark, rough surfaces such as plowed fields absorb the sun's energy much better than do reflecting surfaces such as water or light surfaces.
- Land surfaces concentrate heat at their surfaces and therefore lose heat very rapidly. When water is heated it distributes heat throughout and therefore loses heat more slowly.
- Cloud cover at night tends to reflect heat back to the earth. This prevents heat loss and tends to cause air temperatures to be higher than temperatures would be on a clear night. The opposite is often the case during the day. Increased amounts of CO_2 and other air pollutants reflect heat back to earth. This has come to be known as the "Greenhouse Effect."
- Increases or decreases in water vapor in the air affect heat retained in the atmosphere as well as various sky conditions such as fog and clouds.
- Altitude affects air temperature also. For every 1000 feet rise in elevation, air temperature decreases by 3.5° F.
- Seasonal and daily cycles also cause changes in air temperature. The rotation of the earth and the revolution of the earth around the sun cause differences in the amount and intensity of solar radiation reaching areas of the earth's surface.

Question 4: What causes high and low temperatures to occur in the atmosphere?

Answer: High and low temperatures are the result of the accumulation of heat energy being radiated into the atmosphere during the sunlight hours and the loss of heat energy without replenishing it during the night.

Question 5: When do the high and low temperature readings occur?

Answer: There is a lag time in which the surfaces of the earth give off energy as they receive it from the sun. One might expect the noontime to be the hour for the high temperature reading, but the surfaces retain for a while the solar energy that has been absorbed. This energy is released into the atmosphere to create a high reading between 2 and 4 p.m. on an average day. The low temperature reading usually occurs just before sunrise.

Question 6: How is air temperature measured?

Answer: Air temperature is measured with any type of thermometer. The thermometer needs to be calibrated if accurate reporting of temperatures is to be done.

Question 7: How can a thermometer be calibrated?

Answer: There are several methods. The following is a simple process: Fill a styrofoam cup with crushed ice in a small amount of water. Place the bulb end of the thermometer about two centimeters in the ice. Leave the thermometer in the ice for at least two to four minutes. Remove the thermometer from the ice and read the temperature. The reading shoud be 0° C. or 32° F. If the thermometer shows a different reading, add or subtract the degrees necessary to made the reading 0°C. or 32°F. The number of degrees that are added or subtracted is the degree of error for the thermometer. This number will have to be added or subtracted each time the thermometer is used. Label the thermometer with its degree of error.

To adjust the thermistor in SCIENCE TOOLKIT see page 30 in manual.

HANDOUT #5

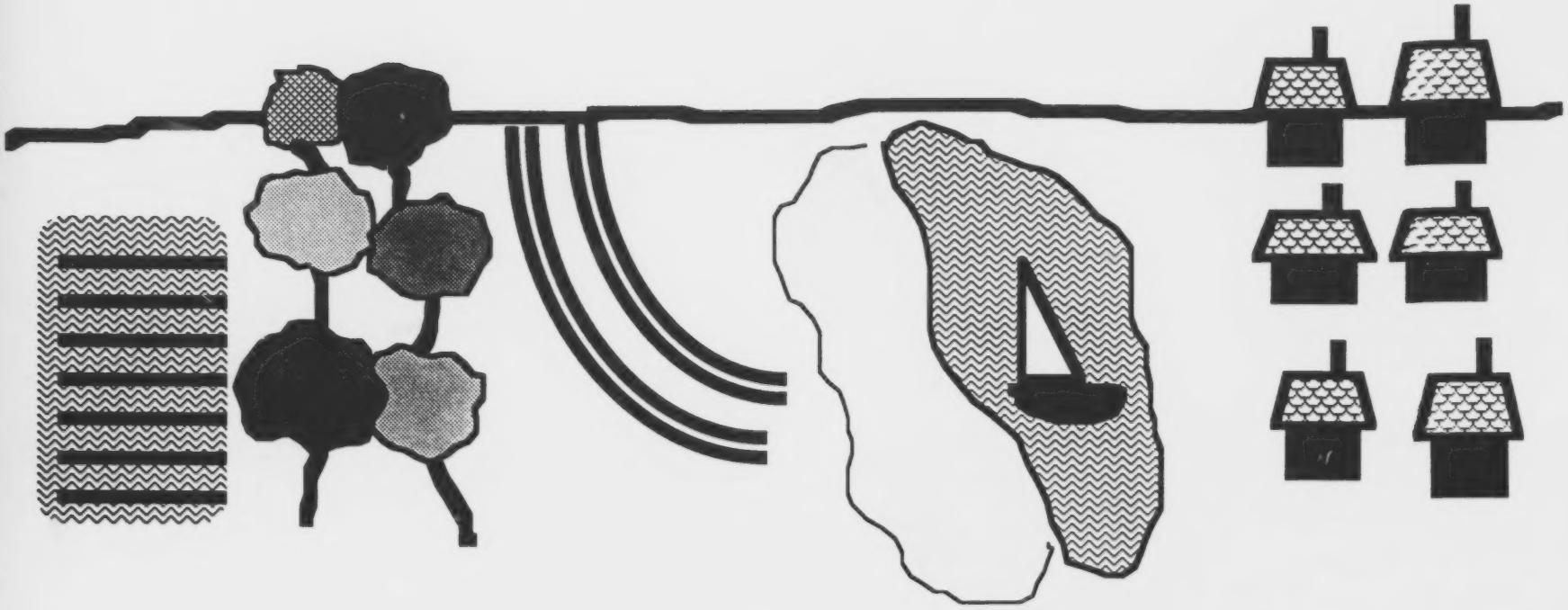
TEMPERATURE DATA CHART

	TEMPERATURE AFTER 2 MINUTES	TEMPERATURE AFTER 5 MINUTES	TEMPERATURE AFTER 10 MINUTES	TEMPERATURE AFTER 15 MINUTES	TEMPERATURE AFTER 5 MINUTES	TEMPERATURE AFTER 10 MINUTES	TEMPERATURE AFTER 15 MINUTES
CUP # 1 WATER							
CUP # 2 DRY SAND							
CUP # 3 MOIST SAND							
CUP # 4 DRY SOIL							
CUP # 5 MOIST SOIL							

TURN ON LIGHT SOURCE

TURN OFF LIGHT SOURCE

Draw a line to show how this bird would glide on air currents from A to B.



Freshly Plowed Field

Stand of Trees

Super Highway

Sandy Beach

Lake

Small Town

SOARING BIRD

HANDOUT #6

Question 1: What determines the three states of water?

Answer: Water is found in three conditions or states: Liquid, solid (ice), or gas (water vapor). The state is determined by both temperature and surrounding pressure (usually air pressure).

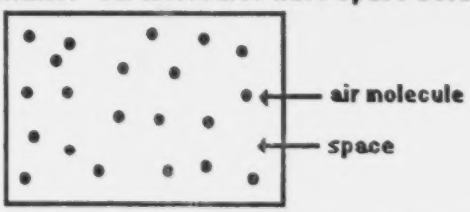
Question 2: How can we describe water vapor or the gaseous state of water in the air?

Answer: Water vapor CANNOT - be seen - be felt - be smelled - be tasted! It is all around us but we cannot directly sense it. There are some indirect indicators of water vapor in the atmosphere:

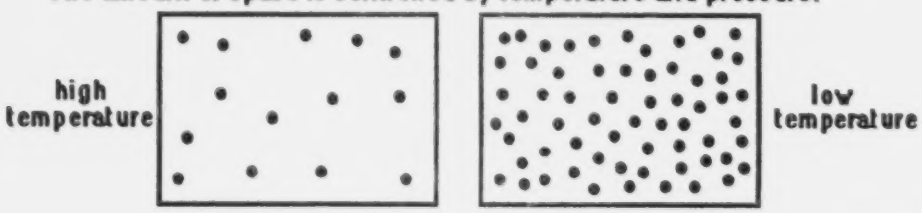
- We are physically uncomfortable when the water vapor is high (muggy, damp, etc.).
- Static electricity is in the air when there is a low amount of water vapor.
- Cold surfaces (drinking glasses) "sweat" in high amounts of water vapor.

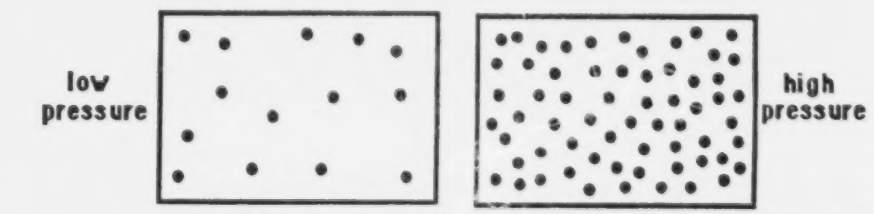
Question 3: What is relative humidity?

Answer: Relative humidity is only one method of describing "how much water vapor the atmosphere contains." Air molecules have space between them.

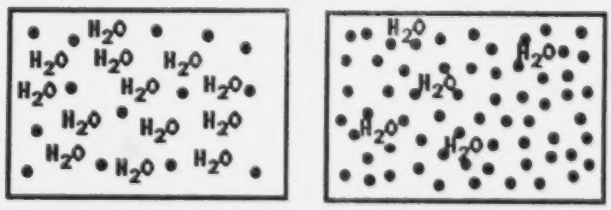


The amount of space is controlled by temperature and pressure.





The amount of space determines the number of water vapor molecules that can be present.

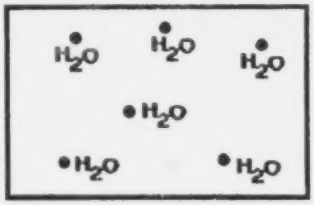


As you can see, the diagram on the left indicates conditions where more water vapor molecules can be present.

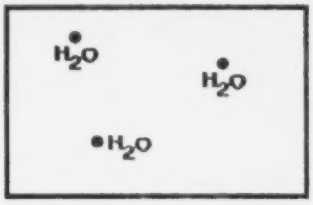
Question 4: How is relative humidity determined? HANDOUT # 7

Answer: Relative humidity is a percentage or ratio of how much water vapor is actually present compared to how much the air could possibly hold at the present temperature and pressure.

This air parcel at 20°C. can possibly hold six water vapor molecules.



However, for some reason (and usually the reason is how much water vapor is available) the air has only three water vapor molecules.



This air actually has 1/2 of the water vapor molecules that it could have at the present temperature. We say that this air has a relative humidity of 1/2 or 50%.

When the air has all the water vapor it can possible hold, the relative humidity is 100%.

Question 5: What happens to relative humidity when the temperature is changed?

Answer: We know that as the temperature is lowered, the space between the molecules will decrease. If the air at 20° C. has enough space for six water vapor molecules then as the temperature changes to 10° C. the amount of space available for water vapor molecules is 1/2 as much or three. That means at 20° C. with three water vapor molecules present, the relative humidity is 50%. With NO CHANGE in water vapor content (3 molecules) and a temperature reduction to 10° C., all available space for water vapor molecules is occupied. The relative humidity is 100%.

MAJOR CLOUD TYPES

HANDOUT #8

CIRROSTRATUS	CIRRUS	CIRROCUMULUS
STRATUS	STRATOCUMULUS	NIMBOSTRATUS
CUMULUS	ALTOCUMULUS	CUMULONIMBUS

NORTH	SOUTH
EAST	WEST

General Weather Conditions:

QUESTIONS AND ANSWERS - WIND **HANDOUT #10**

Question 1: What is wind?

Answer: Wind is air in motion.

Question 2: What causes wind?
Temperature or heat differences between areas. (See questions on temperature.)

Question 3: What causes differences in wind strength?

Answer: The difference in heat from one place to another determines wind strength (Great difference - strong wind / little difference - no wind).

Question 4: What causes differences in wind direction?

Answer: The primary factor in wind direction is the rotation of the earth. Other causes include physical features such as mountain ranges, shorelines, vegetation, and large areas of concrete such as parking lots. The passage of weather fronts is also a contributing factor.

Question 5: Where does wind occur?

Answer: Anywhere in the atmosphere.

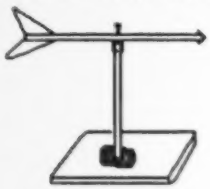
Question 6: Why is wind important?

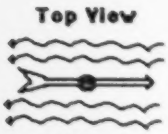
Answer: Wind affects many of our daily activities -- aviation, sailing, farming, and recreation.

Question 7: How is wind measured?

Answer: Two features are considered in the measurement of wind -- direction and speed.

WIND VANE - Measures wind direction



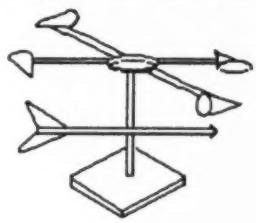


A. EAST

B. NORTHWEST

ANEMOSCOPE - Measures wind speed

ANEMOMETER - Measures wind direction and speed



Formula for calculation of wind speed:

circumference x revolutions per minute x .001 = miles per hour

- Measure (inches) the diameter of the anemoscope (Measure from the outside end of one cone to the outside end of the opposite cone.).

- Multiply the diameter by 3.14 to determine distance of one complete revolution. This is the circumference. Record the circumference on the side of one of your cones.

- Count the number of complete revolutions per minute. The odd colored cone will help with this count.

- Multiply the number of revolutions by 60. This is inches per hour.

- Divide the inches per hour by 63,360. This is miles per hour.

Question 6: What does the atmosphere do for the earth? HANDOUT #12

Answer: When compared to the thickness of the earth, the atmosphere is only a thin blanket surrounding the globe. This blanket consists of about 80% nitrogen and 20% oxygen plus a few other traces of gases. The atmosphere protects us from bombardment of meteors and harmful temperature extremes. Without its protection, surface temperatures would reach 200°F. (93°C.) during the day and about -280°F. (-137°C.) at night.

Question 7: How could the atmosphere be described?

Answer: We think of air as being colorless, odorless, and weightless. The first two descriptions are true, but air in the atmosphere does have weight.

Question 8: Why does the atmosphere have weight?

Answer: The atmosphere is held around the earth by the force of gravity. As one approaches the earth from outer space, each layer of the atmosphere is thicker and heavier. All of the air in the atmosphere is stacked above the earth's surface causing a pressure on all objects on or near the earth.

Question 9: How much does the atmosphere weigh?

Answer: About one ton (2,000 lbs.) of air pushes against each square foot of the earth's surface. This is about 14.7 lbs. per square inch.

Question 10: Why doesn't all this weight crush us?

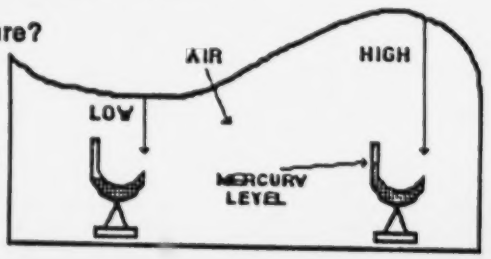
Answer: Fortunately, we are accustomed to this amount of pressure and it is not felt by us. This is due to the fact that the pressure is exerted in all directions in the atmosphere and that it equalizes so that we do not feel pressure from only one direction. Otherwise, we might be flattened like a pancake.

Question 11: How do we measure air pressure?

Answer: A barometric tube of mercury can be used to weigh air. The rising or falling mercury tells us if the air pressure is high or low. The vertical height of the atmosphere behaves like the ocean with crests and troughs. On weather forecasts the barometric pressure is usually given in inches of mercury.

Question 12: Why do we need to measure air pressure?

Answer: Because most storms occur in low pressure areas, a barometer can be a very important instrument. Changes in air pressure may reflect a change in the weather.



Break the Stick

Describe what happens and tell why you think it happened!

Egg in the Bottle

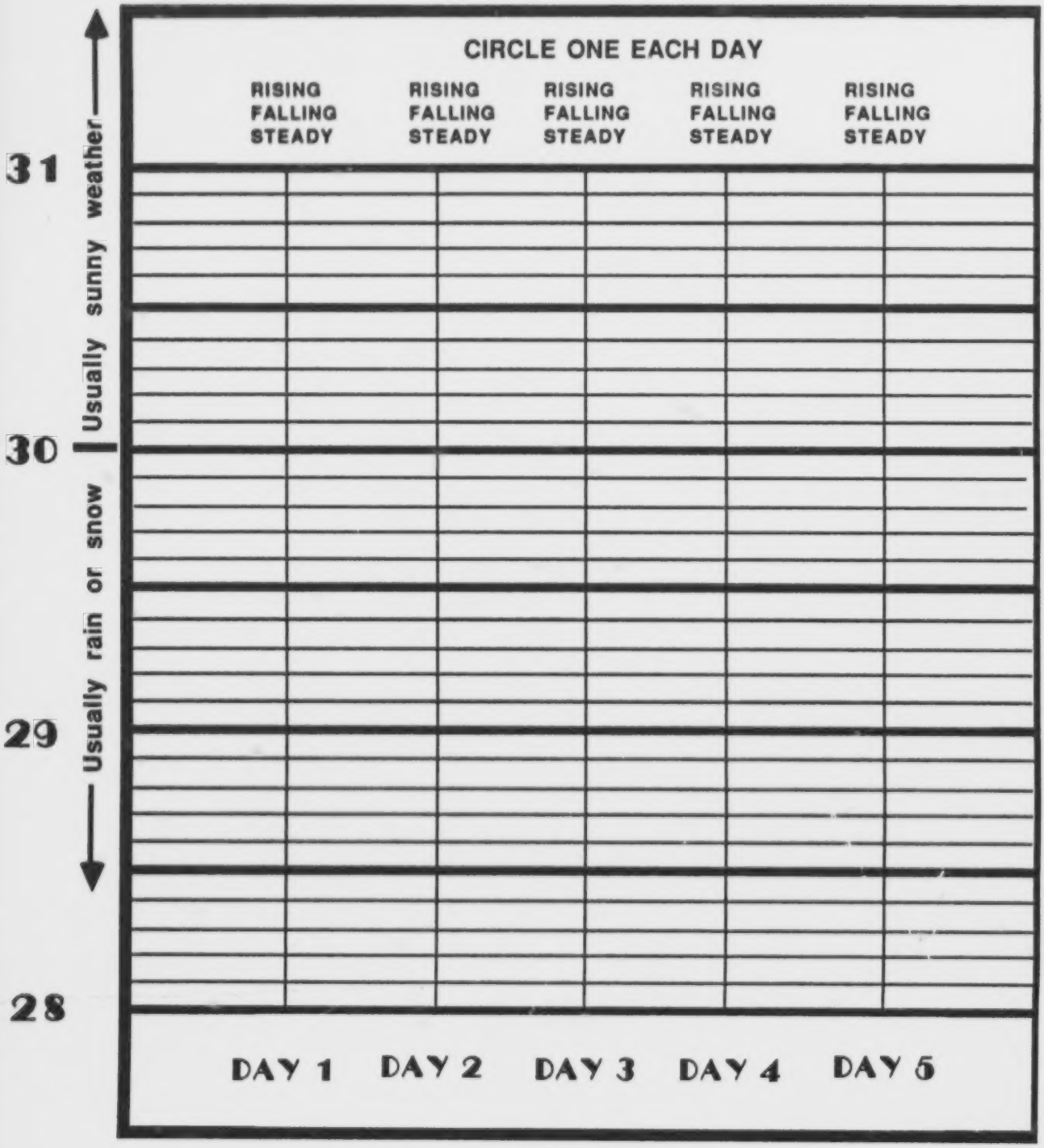
Describe what happens and tell why you think it happened!

Milk Carton

Describe what happens and tell why you think it happened!

AIR PRESSURE GRAPH

HANDOUT # 14



The Weather Station

The Weather Station Circle

Weather conditions around the world are observed and shared with other people for the purpose of knowing existing conditions and for predicting future weather conditions. One of the ways this weather information (data) is shared and used is by entering (plotting) the data on a map.

Each weather observing/reporting station in the world is found on some map created especially for the purpose of plotting important weather conditions. The location of each station on the map is indicated by an OPEN CIRCLE with an identifying number or letters under it. For example, Wilmington, North Carolina is shown on a weather map in this manner:

At the same time, everywhere on the earth, weather people observe and report the conditions existing at their location. Interested people take this reported weather and enter it (in a standard form) around and inside a WEATHER STATION CIRCLE.

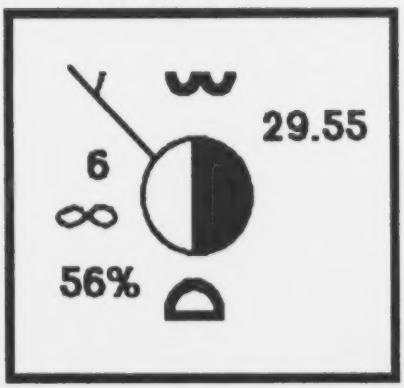
For our activities, the standard form, used throughout the world, has been simplified for ease of use.

ACTIVITY 1

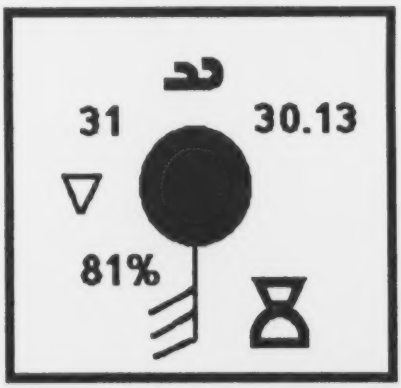
HANDOUT #15

Use the WEATHER STATION CIRCLE Information Sheet to help you answer the questions.

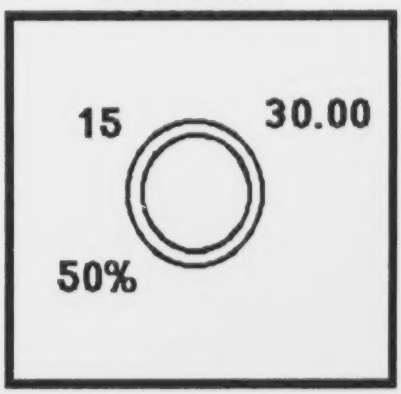
STATION A



STATION B



STATION C



1. At STATION A, the relative humidity is 56%. What is the atmospheric (air) pressure?

   _____

2. The two types of clouds at STATION B are cirrus and _____.

3. The sky is clear of clouds at STATION C and the temperature is

   _____° C.

4. Which STATION is experiencing showers? _____ Haze?_____

5. Which STATION is warmest? _____Its temperature is _____°C.

6. Which STATION is coldest? _____Its wind speed is _____knots.

7. The wind at STATION C is 5 knots 30 knots calm . (circle one)

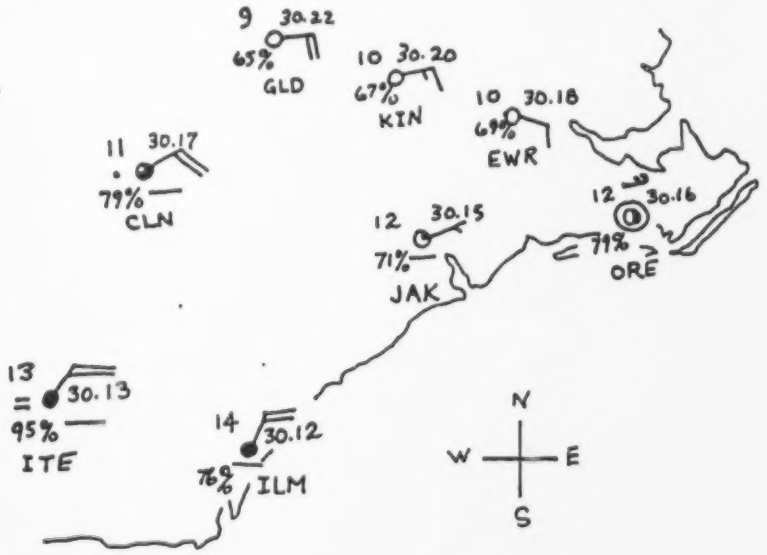
ACTIVITY 2

Use the WEATHER STATION CIRCLE Information Sheet to help you answer the questions.

This is a map of southeastern North Carolina. Weather reporting stations are identified and located as follows:

GLD - Goldsboro
KIN - Kinston
EWB - New Bern
ORE - Morehead City
JAK - Jacksonville
CLN - Clinton
ILM - Wilmington
ITE - (What do you think?)

On this map of weather reporting stations, Morehead City has a temperature of 12°C. and Clinton is reporting stratus clouds.



« What is . . . .

the relative humidity in Goldsboro? _____%

Jacksonville's atmospheric (air) pressure?_____ inches of mercury.

the difference in Kinston's and Wilmington's temperature? _____°C.

« Besides the fog shown at ITE, where is another location where current

weather is occuring? _____

What is that weather?_____

« Write the name of the location shown as ITE._____

« The flow of wind over the WESTERNMOST locations is generally from

the SOUTHWEST NORTHEAST NORTHWEST SOUTHEAST (circle one)

« Skies are cloudiest in the

NORTH SOUTH (circle one)

ACTIVITY 3 (Part 1)

In this activity, you will study a weather system crossing North Carolina from WEST to EAST (This is normally how systems progress.). The first map in the series shows weather conditions at 6AM (0600). Notice that each succeeding map is 6 hours later than the previous one. For example: After 0600, the conditions are given at 12:00 noon (1200).

In this activity you will note the location of the COLD FRONT on each map and look for weather changes that occur at the different locations the front has passed. For example:

At 0600, the COLD FRONT (shown as) is located approximately north/south and to the east of Asheville and to the west of Boone.

1. The driest air is to the west of the COLD FRONT. You can determine that by looking at the relative humidities at Asheville and Boone.

   a. What is the relative humidity in Asheville?_____%
   b. Is the relative humidity in Boone HIGHER/LOWER than Asheville's? _____
   c. Is the driest air associated with the HIGHEST/LOWEST relative humidity? _____

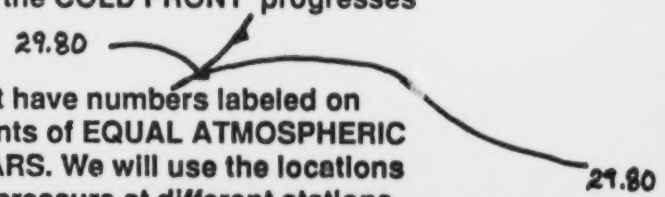
2. Which location is in the COLD AIR? Asheville or Boone? _____

3. The WARM AIR is associated with what wind direction? northwest or southwest? _____

Other things to look at that are important around a COLD FRONT are:

Atmospheric (air) Pressure
Current Weather
Wind Speed
Sky Cover
Cloud Type

Study the differences between Asheville and Boone. These are the weather conditions that you will notice as the COLD FRONT progresses to the East.



You will also notice lines on the maps that have numbers labeled on each end. These are lines connecting points of EQUAL ATMOSPHERIC PRESSURE. These lines are called ISOBARS. We will use the locations of the ISOBARS to compare atmospheric pressure at different stations.

Activity 3 (Part 2)

HANDOUT #15

Look at the 1200 (12:00 noon) map.

The COLD FRONT has progressed eastward until it is now located very near Winston-Salem and Charlotte. The WIND DIRECTION and TEMPERATURE shows Winston-Salem to be to the west of the COLD FRONT and in the cold air.

4. Comparing the Winston-Salem weather at 0600 and 1200, another indication that the COLD FRONT has passed Winston-Salem is the:

   a. WIND DIRECTION has gone from _____ to _____.
   b. TEMPERATURE has gone from _____°C. to _____°C.

   COLD AIR is always to the WEST/EAST of a COLD FRONT. (circle one)

5. Identify the following changes in Charlotte's weather between 0600 and 1200:

   a. Sky Cover 0600_____ 1200 _____
   b. Cloud Type 0600_____ 1200_____
   c. Current Weather 0600 _____1200 _____
   d. Wind Speed 0600 _____ 1200 _____

   Has the COLD FRONT passed Charlotte on the 1200 map? _____

6. At sometime between 0600 and 1200, the COLD FRONT went past Boone. You can determine this because:

   a. The temperature went from _____ to _____.
   b. The Atmospheric pressure changed from ____to_____.
   c. The sky cover changed from _____to _____.
   d. The relative humidity lowered from _____to _____.
   e. The wind direction was _____at 0600 and is _____ at 1200.
   f. The wind speed at 0600 was _____ and became _____at 1200.

7. Which part of the COLD FRONT moved eastward faster ? northern or southern? _____

Activity 3 (Part 3)

HANDOUT #15

What you know so far:

- weather systems move toward the east
- air is colder and drier to the west (behind) a cold front
- atmospheric pressure rises when a cold front passes
- wind shifts from the southwest to the northwest with a passing cold front
- skies generally clear up in the cold air behind a cold front
- stormy weather is to the east or ahead of a cold front
- cumulonimbus are near (and usually ahead of) a cold front

Using all the knowledge you have gained to this point, look at the weather occuring in Charlotte at 1200. Consider what will likely happen in the next 6 hours (by 6 PM - 1800). DO NOT LOOK AT THE 1800 MAP!!

Draw and label the conditions you predict will be on the 1800 map at Charlotte. (Finish incomplete entries such as wind speed, etc.)

Do not be confused that the wind direction at Charlotte is not from the northwest as it was in Winston-Salem. The general rule for wind direction when a cold front passes a location is: Wind direction to the east of a cold front is SOUTHERLY (southwest through southeast) and behind the cold front (to the west) is NORTHERLY (northeast through northwest).

NOW LOOK AT THE 1800 MAP....

Were you a good forecaster?

On the 1800 map, notice that WIND DIRECTIONS are almost parallel to the ISOBARS. This is a good general rule.

Activity 3 (Part 4)

HANDOUT #15

Comparing the location of the COLD FRONT at 0600, 1200, and 1800, you will notice that the northern end of the front has moved eastward at a greater speed than the southern end. This is not always the case, but for this activity remember this fact!

8. At 1800, what location is closest to the cold front and still in the warm air?

   _____

DO NOT LOOK AT THE 2400 MAP TO ANSWER QUESTIONS 9 - 11.

9. Do you think that the cold front will pass this location by the 2400 (midnight) map? _____

10. What do you predict the wind direction will be in Laurinburg on the 2400 map? _____

11. Wind speed normally increases as a cold front gets closer. What would be a reasonable prediction or FORECAST of wind speed in Greenville at 2400? _____

Now look at the 2400 map and study the weather in Asheville, Charlotte and Laurinburg. If you are alert, you will see that a new type of weather front has appeared. A WARM FRONT is coming into the picture. This type of front has certain differences in weather, wind and clouds from those of a cold front.

12. What type of weather appears in the cold air and near the warm front? _____

13. The cloud type at Charlotte is _____ and that is different than the _____ cloud type found at Elizabeth City.

Activity 3 (Part 5)

By now, you may have a "feel" for predicting future weather based upon trends from the past. Without looking ahead to the final map (a second day at 0600), do your best to forecast weather elements at the following specific locations.

My forecast for the 0600 time at the following locations is:

Raleigh
Cloud Cover 0 1/4 1/2 3/4 overcast (circle one)
Temperature _____
Atmospheric Pressure _____

Greenville
Relative Humidity _____
Wind Direction _____
Current Weather none rain showers (circle one)

Elizabeth City
Wind Speed _____
Wind Direction _____
Temperature _____

Hatteras
Cloud Cover 0 1/4 1/2 3/4 overcast (circle one)
Relative Humidity _____
Current Weather none rain showers (circle one)

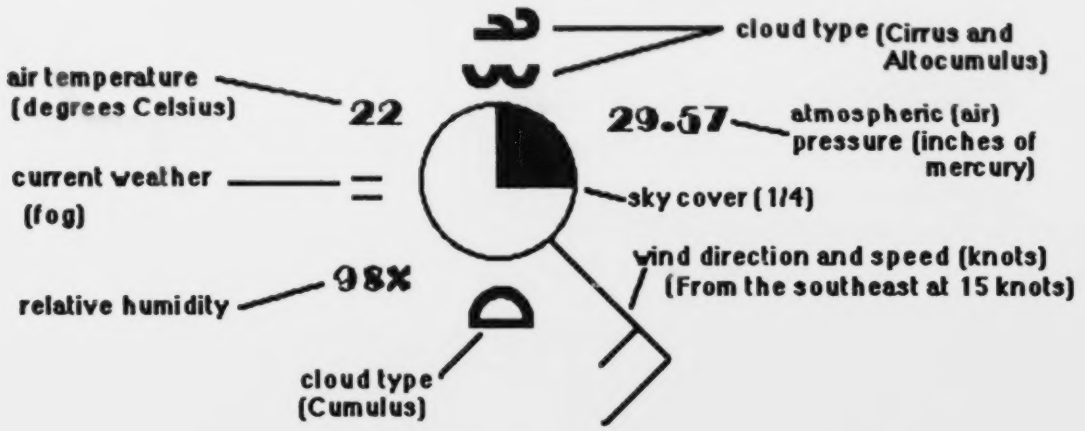
This one may be difficult, but give it a try:

Asheville Complete the station circle:

After completing this page, check your forecasts by looking at the second day 0600 map. Discuss any major differences with your teacher and other members of your class.

WEATHER STATION CIRCLE

HANDOUT #15



WIND

Wind direction is given FROM WHICH it is blowing. For example:

The wind is blowing from the North.

Wind speed is given in knots (nautical miles per hour). It is shown by lines added to the direction indicator. Each long line equals 10 knots. Each short line equals 5 knots. For example:

The speed here is 25 knots with a direction of South.

A circle drawn around the Station Circle indicates Calm (no wind). For example:

CURRENT WEATHER

- Rain
- Snow
- Showers
- Fog
- Haze
- Thunderstorm
- Tornado

NOTE: No symbol in this location means that no restrictions to visibility exist at that time.

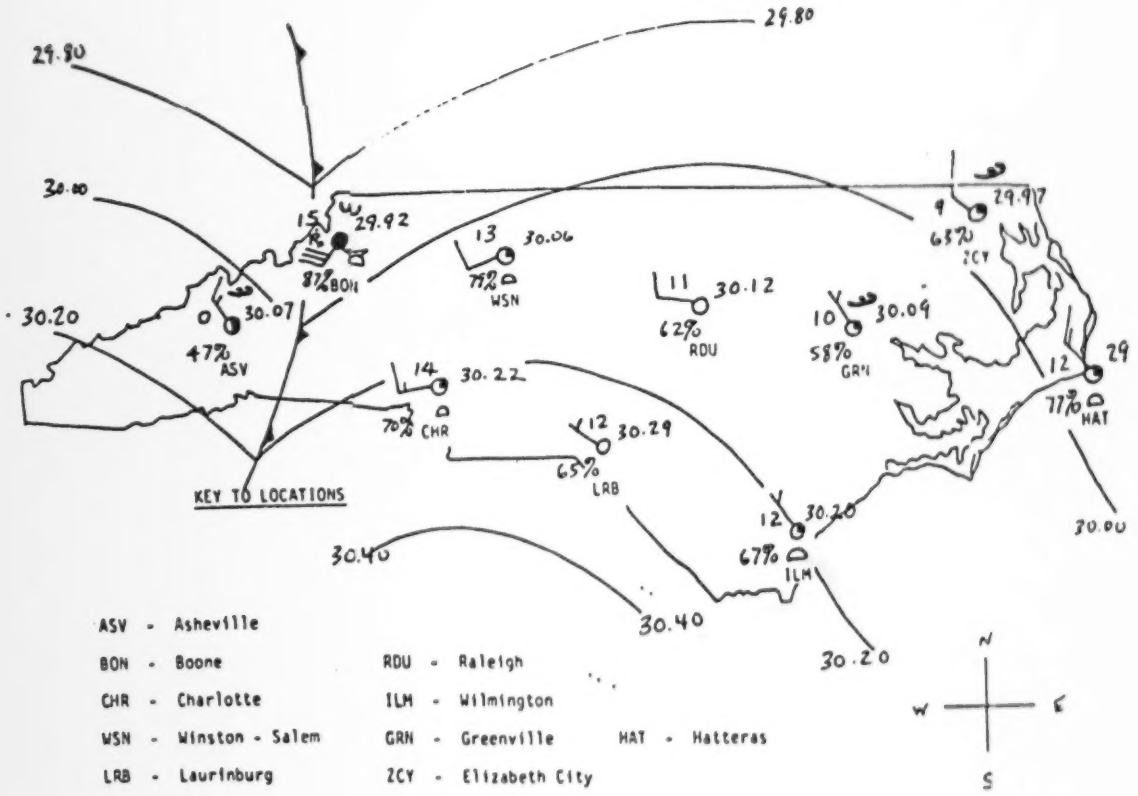
For this model current weather is considered those conditions that restrict how far you can see. (Only reported when visibility is less than 7 miles.)

CLOUDS/SKY COVER

- Cumulus
- Stratus
- Cumulonimbus
- Altocumulus
- Cirrus

- Clear
- 1/4 cover
- 1/2 cover
- 3/4 cover
- Overcast

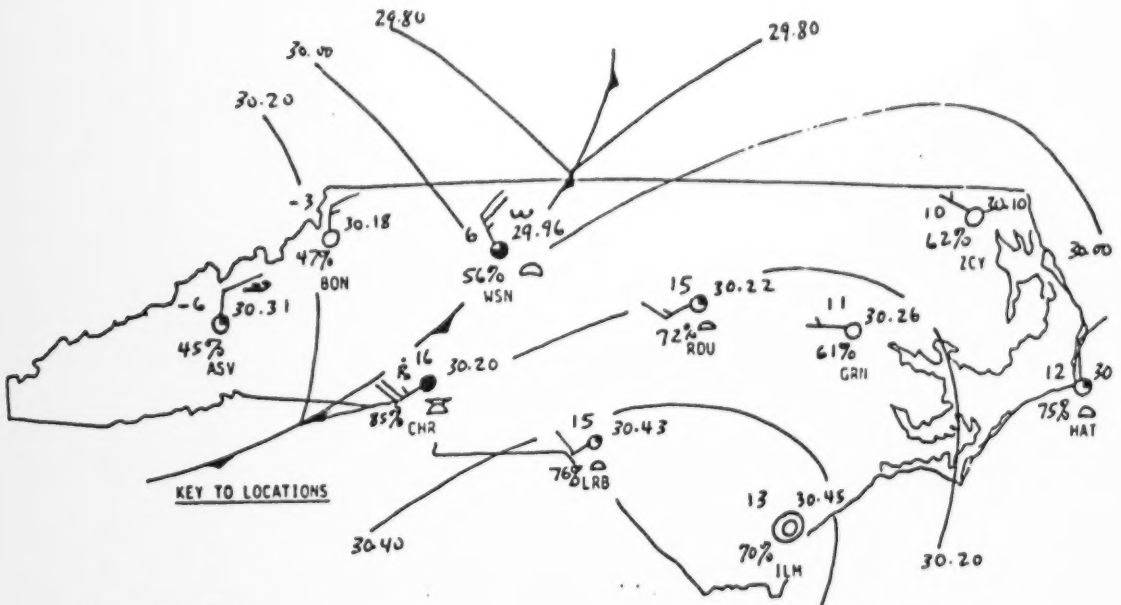
TIME : 0600 (6 AM)



ASV - Asheville
BON - Boone
CHR - Charlotte
WSN - Winston - Salem
LRB - Laurinburg
RDU - Raleigh
ILM - Wilmington
GRN - Greenville
ZCY - Elizabeth City
HAT - Hatteras

N
W
E
S

TIME : 1200 (12 NOON)



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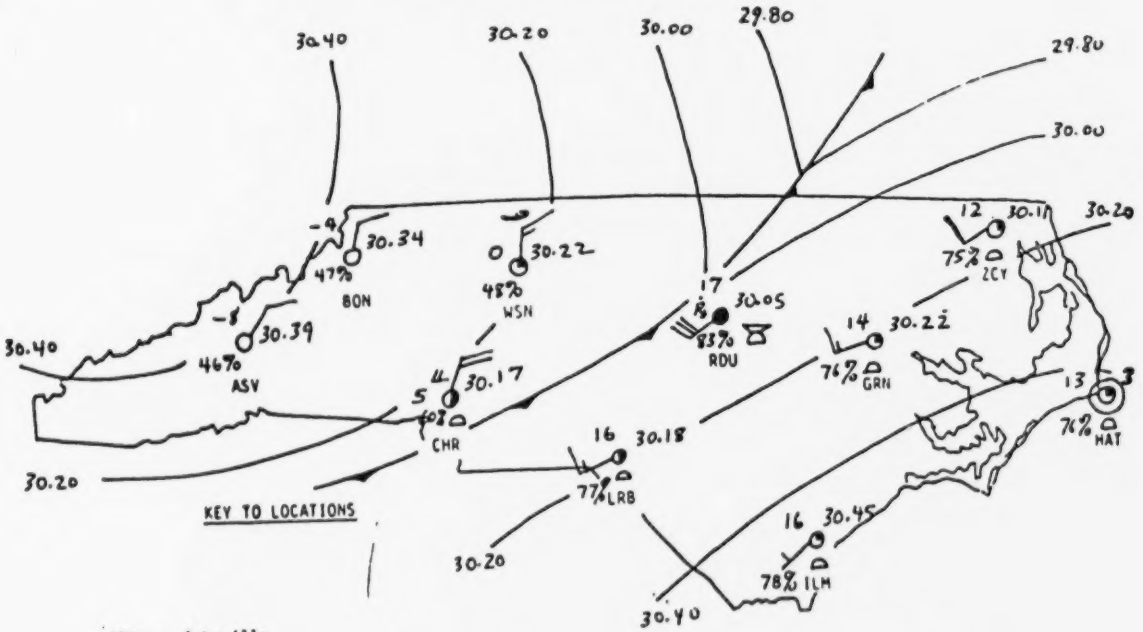
LRB - Laurinburg
RDU - Raleigh
ILM - Wilmington
GRN - Greenville
ZCY - Elizabeth City
HAT - Hatteras

N
W
E
S

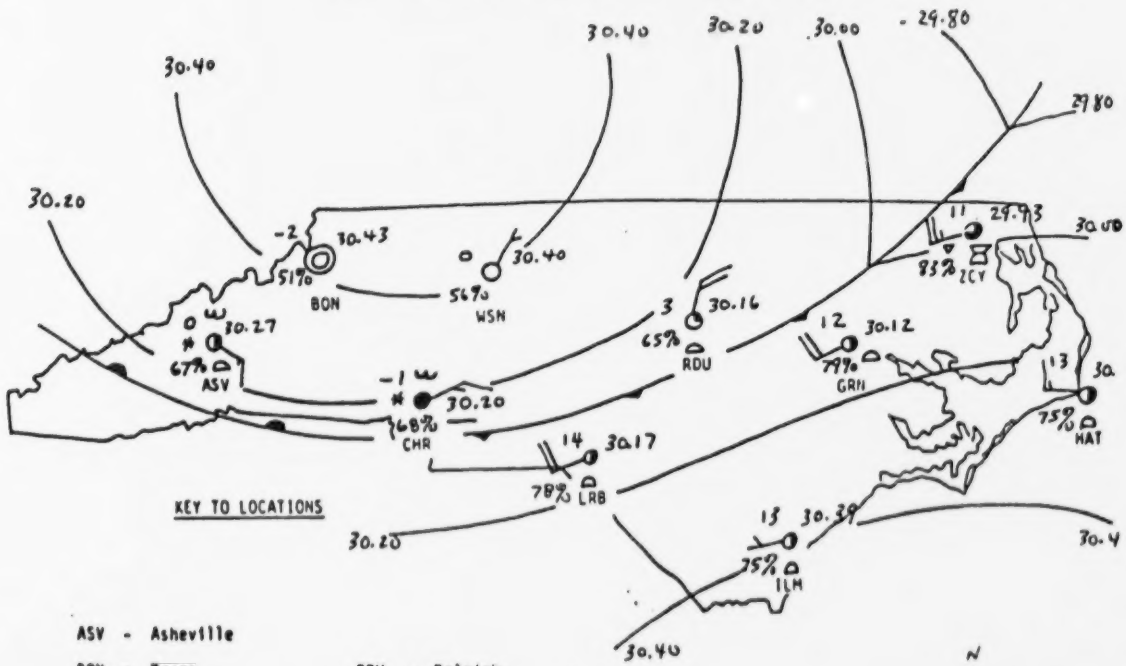
TIME : 1800 (6 PM)



KEY TO LOCATIONS

ASV	- Asheville				
BON	- Boone	RDU	- Raleigh		
CHR	- Charlotte	ILM	- Wilmington		
WSN	- Winston - Salem	GRN	- Greenville	HAT	- Hatteras
LRB	- Laurinburg	ZCY	- Elizabeth City		

TIME : 2400 (12 MIDNIGHT)

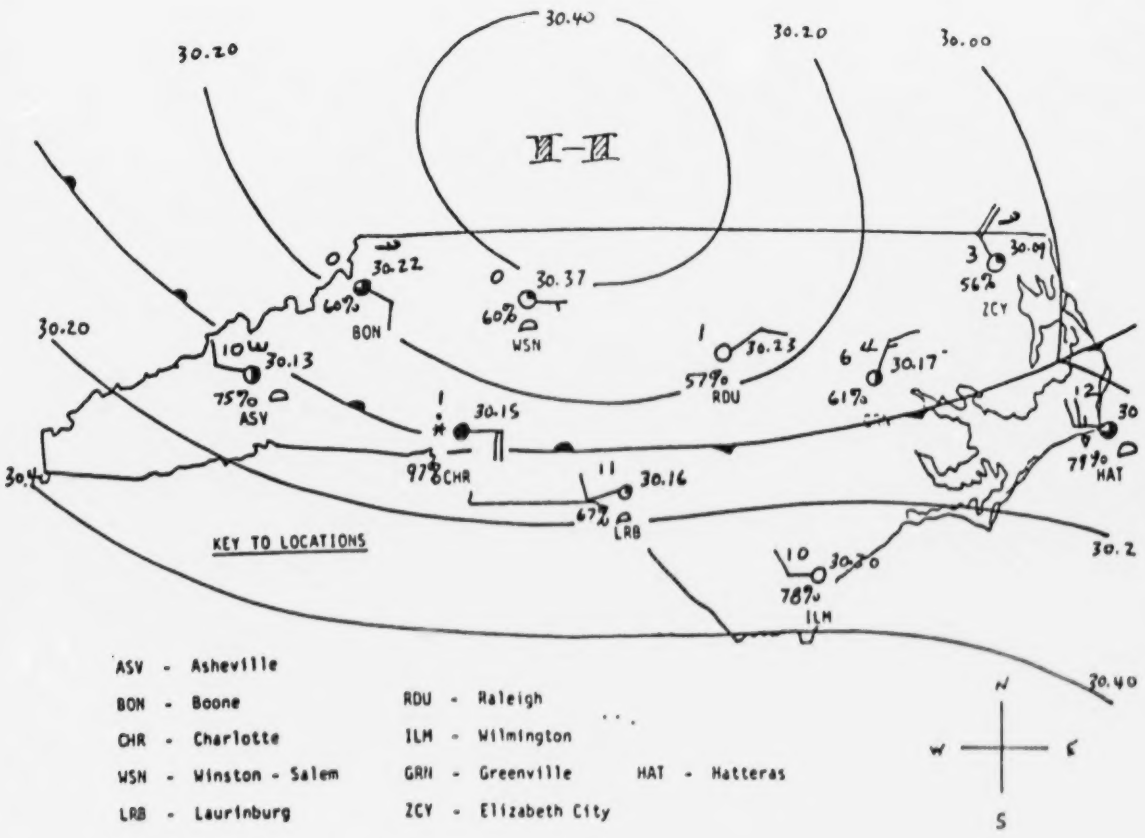


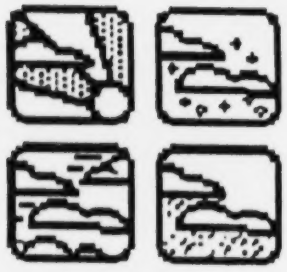
KEY TO LOCATIONS

ASV	- Asheville				
BON	- Boone	RDU	- Raleigh		
CHR	- Charlotte	ILM	- Wilmington		
WSN	- Winston - Salem	GRN	- Greenville	HAT	- Hatteras
LRB	- Laurinburg	ZCY	- Elizabeth City		

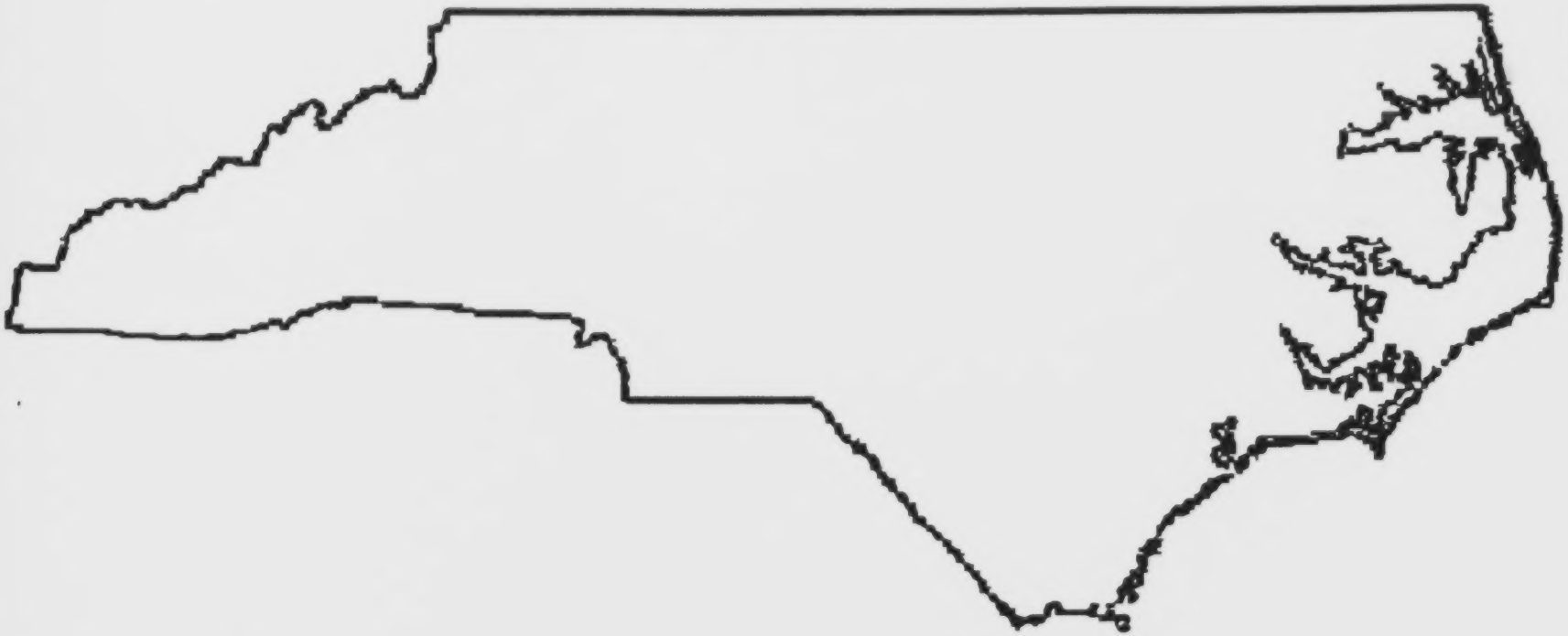
HANDOUT #15

TIME : 0600 (6 AM) Second Day





Weather Plotting Map



WEATHER PLOTTING MAP

HANDOUT #16

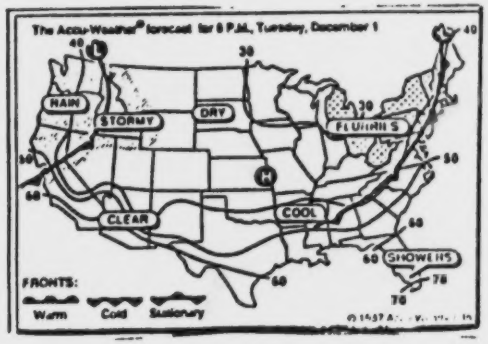
SURVIVAL WEEKEND

Hanging Rock State Park
Stone Mt. State Park
Medoc Mt. State Park
Merchant's Millpond State Park
Mt. Mitchell State Park
Joyce Kilmer Memorial Forest
Crowder's Mt. State Park
Morrow Mt. State Park
Umstead State Park
Cliffs of the Neuse State Park
Singletary State Park
Ft. Macon State Park

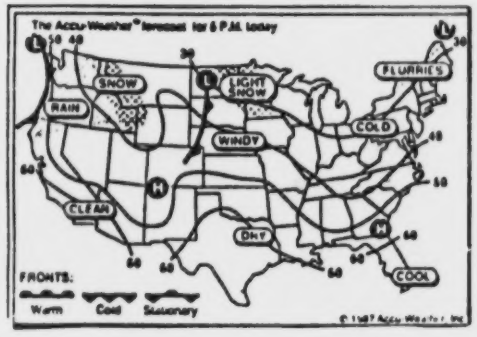
SURVIVAL WEEKEND MAP

HANDOUT #17

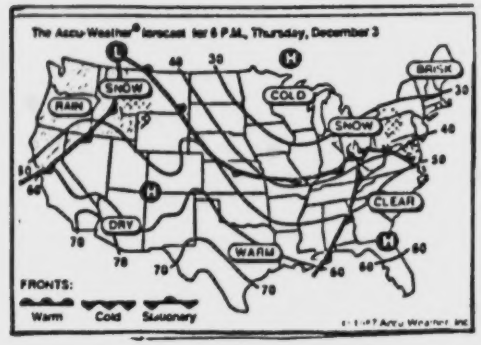
Day 1



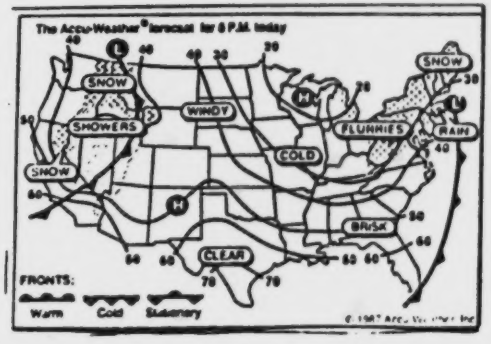
Day 2



Day 3



Day 4



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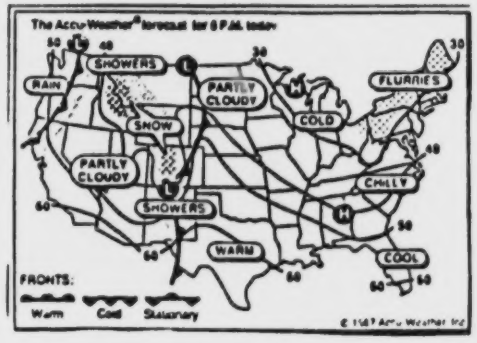
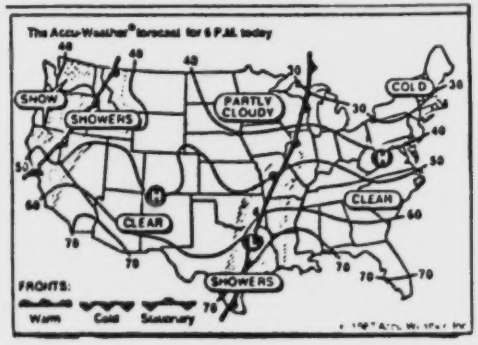


Day 6



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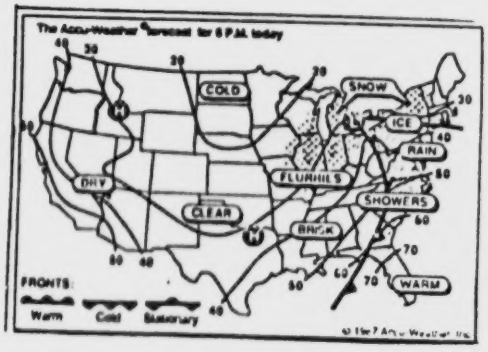
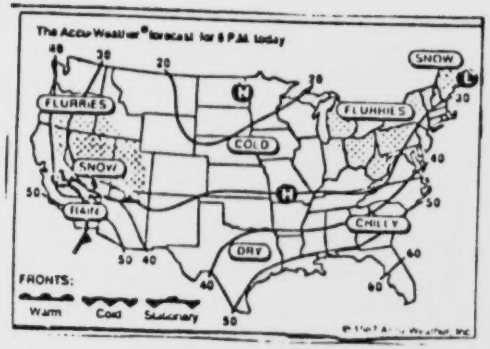
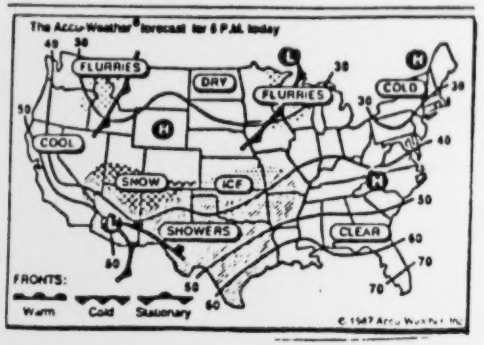


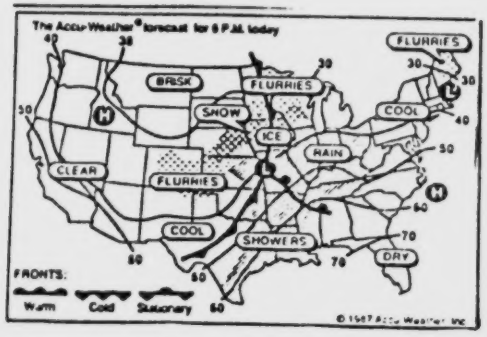
Day 8



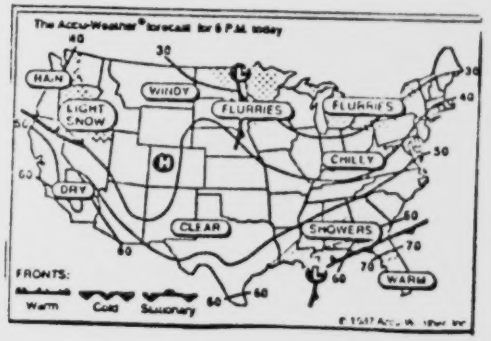
Day 9



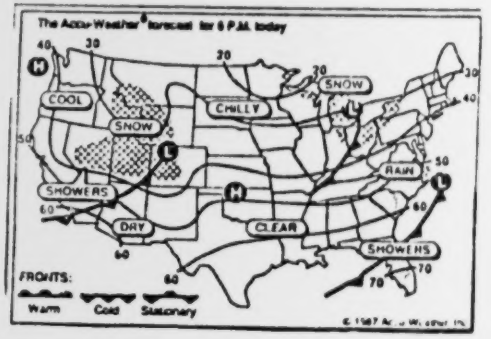
Day 10



Day 11

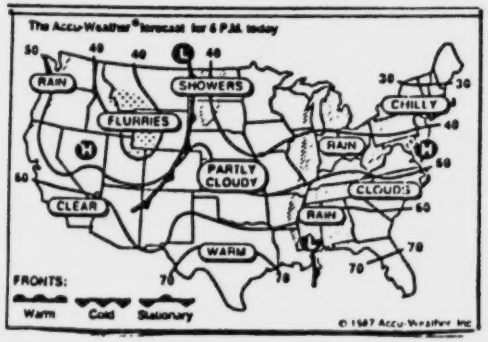


Day 12

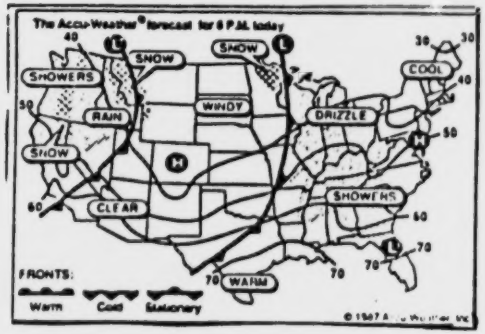


HANDOUT #18

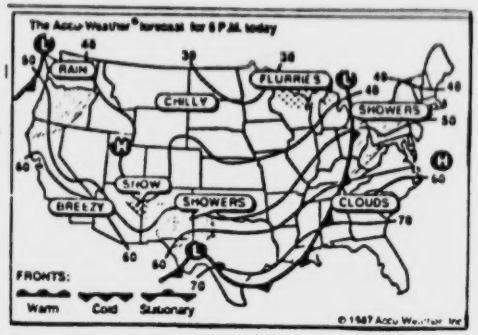
Day 13



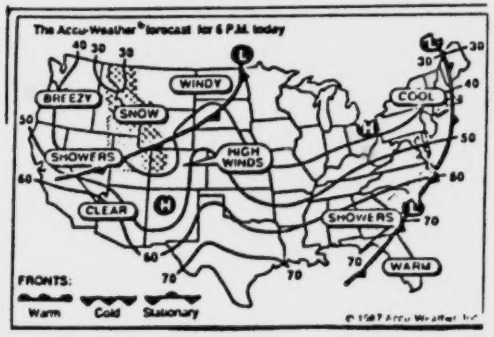
Day 14



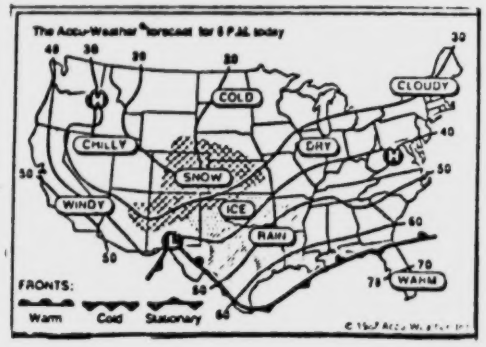
Day 15



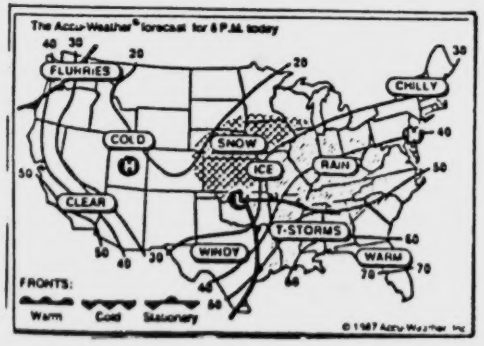
Day 16



Day 17



Day 18



HANDOUT #18

TELECOMMUNICATIONS

SECTION C

FORMAT FOR WEATHERLINKER DATA FILES

SCHOOL
ADDRESS
TIME
RELATIVE HUMIDITY %
BAROMETRIC PRESSURE inches

rising steady falling
PRECIPITATION
type
amount inches
WINDS
speed miles per hour
direction
CLOUD COVER

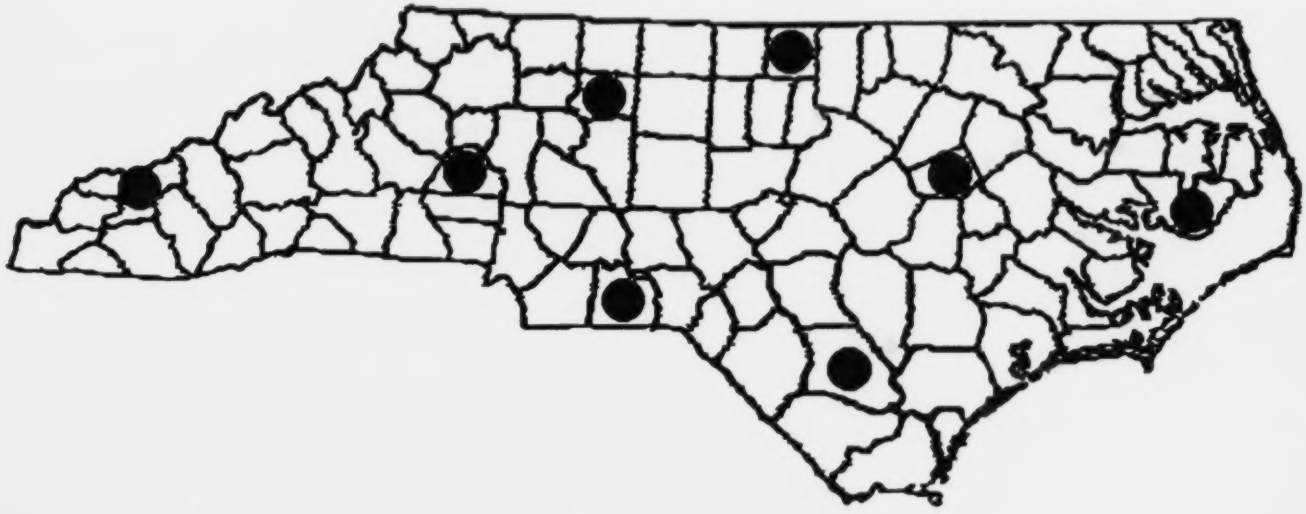
clear 1/4 cover 1/2 cover 3/4 cover overcast
TYPES OF CLOUDS

~~~~~~

(Sample of Completed Data)

SCHOOL Anyschool
ADDRESS Anytown, NC
TIME 10:00 AM
RELATIVE HUMIDITY 85 %
BAROMETRIC PRESSURE 30.25 inches
X
rising steady falling
PRECIPITATION
type none
amount 0 inches
WINDS
speed 24 miles per hour
direction southwest
CLOUD COVER
X
clear 1/4 cover 1/2 cover 3/4 cover overcast
TYPES OF CLOUDS cumulus
~~~~~~

FrEdMailer NetWork



Telecommunications	*Voice*
BRYSON CITY - 704-488-2290	LEONARD WINCHESTER - 704-488-2152
HICKORY - 704-256-8136	TERRY BLEDSOE - 704-256-6240
WADESBORO - 704-694-4523	SUZANNE GRIFFIN - 704-694-4885
WINSTON-SALEM - 919-727-2529	TOM CLAUSET - 919-727-2213
ROXBORO - 919-597-8528	DAVID WARLICK - 919-599-2191
WILSON - 919-243-1601	E. D. HALL - 919-243-2900
ELIZABETHTOWN - 919-862-8998	HERB MCINTYRE - 919-862-6170
SWAN QUARTER - 919-926-0953	ALAN TROUSDELL - 919-926-4521

A FEW TIPS ON -----

How to Use FREDMAILER - The E-Mail System

How to Use FREDSENDER - The Telecommunications Program

How to Use FREDWRITER - The Word Processing Program

CONTENTS

ENTERING TELEPHONE NUMBERS	PAGE 1
DIALING FREDMAILER	PAGE 1-2
READING SCIENCE MESSAGES	PAGE 3
SENDING SCIENCE MESSAGES	PAGE 4
SAVING SCIENCE MESSAGES	PAGE 6
PREPARING A NEW FILE	PAGE 6
USING A SAVED FILE	PAGE 7
PRINTING A FILE	PAGE 8

This manual is intended for science teachers who might need help in using telecommunications for the first time. The directions are for those who are using FREDSENDER (communications) and FREDWRITER (wordprocessing). These programs are available at no cost (other than the disk) from each system level computer coordinator and regional center in North Carolina. If other titles will be used, the directions for each individual program should be followed.

Entering Telephone Numbers Before Using FREDSENDER

Before you use FREDSENDER for telecommunications, you must first enter the telephone number you plan to use in the program's directory. To do this, place FREDSENDER in drive 1 and turn on your computer. You will see the main menu, which has several choices. Select FREDSENDER and press **RETURN**. This statement will appear on the screen:
PLACE YOUR DATA DISK IN DRIVE 2 AND PRESS <RET>.
<SPACE> TO CHANGE. Since you are not using a data disk at this time, press the **space bar** to change the drive to 1 and press **RETURN**. The main strip menu will appear across the top of your screen.
<P>HONE <D>ISK CMDS <E>ND:
Select P for phone. A 20 number phone directory will appear on the screen and another strip menu will be at the top of the screen:
<D>IAL <C>HANGE A PHONE NUMBER
Select **<C>HANGE A PHONE NUMBER**. Enter the directory line number you want to use and press **RETURN**. (Do not select a line that you wish to remain in your directory. When you select a line everything on the selected line is deleted!) The cursor will go to the line you have selected and you may now enter a name for your directory [**return**] - a telephone number (exactly like you would dial from a regular telephone) **[return]** - and a baud rate of either 300 or 1200 (Using 300 at the start will let you read what is happening on the screen. 1200 will be very fast. You can change this later or enter the faster rate on another line of your directory.) **[return]** (If the strip menu still asks you to select the line to change, press **RETURN** again.)

To end this session, press **ESC** and when the main strip menu appears across the top of your screen, select **<E>ND.** This will save the information you have entered in your phone directory.

Using FREDSENDER to Dial FREDMAILER
(For the First Time)

Place FREDSENDER in drive 1 and turn on your computer. You will see the main menu, which has several choices. Select FREDSENDER and press **RETURN**. This statement will appear on the screen:
PLACE YOUR DATA DISK IN DRIVE 2 AND PRESS <RET>.
<SPACE> TO CHANGE. Since you are not using a data disk at this time, press the **space bar** to change the drive to 1 and press **RETURN**. The main strip menu will appear across the top of your screen.
<P>HONE <D>ISK CMDS <E>ND:
Select P. Another strip menu will appear at the top of your screen and the phone directory will be displayed. From the menu, choose **<D>IAL.** You will be asked to select the line number to dial. You will enter the line number for the telephone number you wish to dial. In a few minutes you should hear your modem dialing,

followed by the sound of a telephone ringing (If you should get a busy signal, press **ESC** and then **H** to hangup. Try again.). When FREDMAILER answers on the other end of the line, you will hear a scratchy noise (300 baud) or a high pitched noise (1200 baud). This is the carrier signal and tells you that the two computers are connected. Wait a second after the noise and then press **RETURN**. You should see words on the screen from FREDMAILER which welcome you to the system. Don't type anything else until you are asked for a **USERNAME.** Since this is the first time you have used the system, you will not have a **USERNAME** or a **PASSWORD**. You will have to ask the sysop (system operator) to let you become a validated user of the system. To do this, you type **N** after **USERNAME** to indicate that you are a New User. The system will ask various questions for which you will have to type answers. It will also ask that you create and type a **PASSWORD**. The system makes a **USERNAME** for you by using the first letters in your name. It would be wise for you to record your **USERNAME** and **PASSWORD** so that you don't forget them. You will need them the next time you try to use the system. After you have established these items, you may choose to browse around in the system. However, you will not be able to send or receive messages until the sysop has verified your information. This usually takes only a day or so. When you are ready to leave the system you must have the Main Command Prompt on the screen: **Command (ABCEFGHKMNOPTU?).**
Type **G** for goodbye. The FREDMAILER system will take you off-line. When you see the message, **DISCONNECT . . .**, on your screen, press **ESC** (FREDSENDER users only.). The strip menu across the top of your screen becomes:
<C>apture <S>end <D>isk CMDS <H>angup
You will choose **<H>** for hangup. This hangs up your phone and ends your online session.

Using FREDSENDER to Dial FREDMAILER (After Becoming a User)

Place FREDSENDER in drive 1, and turn on your computer. You will see the main menu, which has several choices. Select FREDSENDER and press **RETURN.** After the data disk question (change data disk to drive 1), the main strip menu will appear across the top of your screen.
<P>HONE <D>ISK CMDS <E>ND:
Select **P.** Another strip menu will appear at the top of your screen and the phone directory will be displayed. From the menu, choose **<D>IAL.** You will be asked to select the line number to dial. You will enter the line number for the telephone number you wish to dial. In a few minutes you should hear your modem dialing, followed by the sound of a telephone ringing (If you should get a busy signal, press **ESC** and then **H** to hangup. Try again.). When FREDMAILER answers on the other end of the line, you will hear a scratchy noise (300 baud) or a high pitched noise (1200 baud). This is the carrier signal and tells you that the two computers are connected. Wait a second after the noise and then press **RETURN.** You should see words on the screen from FREDMAILER which welcome you to the system. Don't type anything else until you are asked for a **USERNAME.** You answer with the **USERNAME** that was given to you. Next, you will be asked for a **PASSWORD.** You answer with the **PASSWORD** that you created. Don't type anything else until

you see the Main Command Prompt that looks like this: **Command (ABCEFGHKMNOPTU?).** Select **B** for Bulletin Boards. Although there are other features in the FREDMAILER system, the WEATHERLINKER Project will use the Science Bulletin Board to exchange weather data.

SCIENCE BULLETIN BOARD
Reading Mail

To get to the Bulletin Boards you will enter the letter **B** from the Main Command Prompt. You will be asked which board you would like to see. Press **?** to get a list of the boards. You should choose the letter that indicates SCIENCE. The Science Board prompt will appear : **[SCI: BEHKRSTQ?]** You are now ready to read your mail (if there is any). You may type **?** to see a list of the commands that are possible from this prompt. Choose **R** to read. You will have the option to read any old messages that are on the board or you may choose to read only the new messages that have not been read (You may choose to start with #1 and read them all). Unless you type in the specific message number that you wish to read, you can press **RETURN** and the first new message header will appear. It will be similiar to this:
25 : SCI JDOE: Test File 03/21/89 [185][RSDQ?]
25 = message number
SCI = name of board
JDOE = person who sent the message
Test File = subject of the mesage
03/21/89 = when the message was sent
[185] = size of the message
[RSDQ?] = You many choose to **<R>ead <S>kip <D>elete <Q>uit** the message.
Press R to read the message and the message will appear on the screen. (See the section on Saving Messages.)

When the message has been shown, it will be followed by another prompt:
[Msg. 25 : ADFKQR?]
Read Msg <A>gain
<D>elete Msg
<F>orward Msg
<K>nowledgable User
<Q>uit Reading Msgs
<R>eply to Msg

If you want to continue reading your messages, just press **RETURN** to go on to the next one. You will not be allowed to delete a message while in the Science Bulletin Board. Only the sysop (system operator) can do this. You will be asked if you would like to reply to the message. You may respond with a **N** if you wish to continue reading your messages. However, there may be times that you will want to respond with a short message. If this is the case, you will press a **Y**. You will be given choices as to whom you would like to respond. Your choices will be 1. The sender's private mailbox 2. SCI (local) or 3. &SCI (Network). Follow the directions under SENDING MAIL from this point.

When you have finished reading your mail you will be returned to the Science Board prompt: **[SCI: BEHKRSTQ?]** Choose **Q** to quit. You will be returned to the Main Command Prompt: **Command (ABCEFGHKMNOPTU?)** This time type **G** for Goodbye. When you see the message, **DISCONNECT . . .**, on your screen, press **ESC** (FREDSENDER users only). The strip menu across the top of your screen becomes: **<C>apture <S>end <D>isk CMDS <H>angup.** You will choose **<H>** for hangup. This hangs up your phone and ends your online session.

SCIENCE BULLETIN BOARD
Sending Mail

Follow the directions for getting to the Science Board as outlined in the READING MAIL section. You may want to read and send mail during the same session. The directions are given in two sections for clarity.

As before, after you choose to see the Science Board, you will see the following prompt: **[SCI: BEHKRSTQ?].** In order to send a file, you should choose **I**. You will be asked if you wish to attach a file. This file would be an already prepared data file. (See the section on preparing a data file.)

TYPING ONLINE or NOT ATTACHING (uploading) A DATA FILE: Answer **N** if you will not upload a data file. (This choice is not recommended except for very short messages. The time spent in typing online will add to the cost of telecommunications and keep others from using the system. However, there may be times that you will want to type a short message.) You will be asked to choose whether you want to send the message to 1. SCI (local) or 2. &SCI (Network). For the WEATHERLINKER Project you will want to choose **2** so that your message will travel over the state network. Next, you will be asked to type in a subject for your message. This should be just a few words that will give a clue as to what your message is about. You will start typing when Line 1. appears. You cannot go back and edit a line once you have left it until the entire message is complete. FREDMAILER will allow you to type 100 lines. When you have finished, press RETURN three times. The following Edit Prompt will appear on the screen: **[Edit: ACDEFHIKLS?]** At this time, you may go back into your message and make corrections by pressing **E** for Edit. You will be asked to give the line number you wish to edit. After retyping the line, you must press **RETURN** three times to get back to the Edit prompt. If your message is ready to be sent, you will press **S** to Send or Save your message. If you are successful, you will get the message: **Msg.26 . . .SAVED!** The Science Board prompt is on the screen and you will press **Q** to quit and return to the Main Command Prompt.

ATTACHING A FILE or SENDING (uploading) A DATA FILE: Answer **Y** if you will upload an already prepared data file. Unless you have a very short message to send, it is better to prepare your message with a word processor when you are not online. Online time costs money and correcting mistakes online is not as simple as it is with a word processor.

Of course, the first thing you will have to do is prepare a file and save it to your data disk. (See the section on preparing files.) The data disk should be in drive 2. When

you start FREDSENDER, **RETURN** to accept the data disk question. Follow the procedure to get online and into the FREDMAILER system. Next, you must get to the Science Bulletin Board section of FREDMAILER as you did before. When the Science Board Prompt appears on the screen:
[SCI: BEHKRSTQ?] you will type a **I** to indicate that you will type a message. When you are asked if you will attach a file, answer **Y**. You will be asked to choose whether you want to send the message to 1. SCI (local) or 2. &SCI (Network). For the WEATHERLINKER Project you will want to choose **2** so that your message will travel over the state network. You will be asked for a subject and then Line 1. will appear. You can type one or two lines at this point, explaining anything you want about the attached file. End your message as usual with three carriage returns. When your message is finished you will choose **S** from the Edit Menu:
[Edit: ACDEFHIKLS?] to send your introductory message. The following message will appear on the screen:
ATTACH #1
[PROTOCOL: CXTQ?] Choosing **X** will indicate that you wish to transfer your prepared file using the X-modem procedure. (Most users of FREDMAILER have discovered that X-modem works best.) Another message will appear on the screen:
TELL YOUR COMPUTER TO SEND XMODEM
XMODEM RECEIVE: CTRL-X TO ABORT
(FREDSENDER users will follow these directions. Other communications programs will have their own directions.) Press **ESC.** The FREDSENDER strip menu appears across the top of your screen:
<C>apture S>end <D>isk CMDS <H>angup. You will choose **<S>end.**
The command line will change to : **FILE TO SEND:** You will type the name of the file that you previously prepared and saved on a data disk (See section on preparing files.) The name of the file is followed by a comma and an X. (To send a file named "test" you would type: **test, x** and then **RETURN.**) You will see the message, **** XMODEM TRANSMIT **** which indicates your file is being transferred. When the transfer is complete, you should follow the directions in the strip line menu :
TRX COMPLETED . . .PRESS <RET>. This message will be on your screen:
[RCV'D: <S>AVE, <C>ANCEL : SC] You will press **S** to Send or Save your file. If, for any reason you do not want the message sent, you may press **C** to cancel. You will be asked **[ATTACH ANOTHER? : YN]** You will choose **N** if you are finished. The last message will say : **[RETURN SEND MSG, OR <C>ANCEL].**
You will press **RETURN** unless you wish to cancel at this point. The Science Board prompt will be on the screen and you will press **Q** to quit and return to the Main Command Prompt.

If you are unable to transfer a file using the X-modem procedure, you may have to use the Text transfer procedure. To do this, you choose **T** from the **[PROTOCOL: CXTQ?]** menu. The following message will appear on the screen:
SEND TEXT
TYPE /END /EXIT WHEN DONE
BEGIN SENDING
:
Press **ESC.** The FREDSENDER strip menu appears across the top of your screen:
<C>apture S>end <D>isk CMDS <H>angup. You will choose **<S>end.**
The command line will change to : **FILE TO SEND:** You will type the name of the file that you previously prepared and saved on a data disk (See section on preparing files.). (To send a file named "test" you would type: **test** and then **RETURN.**) You

will see your file going across the screen. When it has finished, you should follow the directions in the strip menu, **DONE. . .<RET> TO CONTINUE.** A colon will appear at the bottom of your screen. Type **/END** or **/EXIT** to indicate the end of your file. This message will be on your screen:
[RCV'D: <S>AVE, <C>ANCEL : SC] You will press **S** to Send or Save your file. If, for any reason you do not want the message sent, you may press **C** to cancel. You will be asked **[ATTACH ANOTHER? : YN]** You will choose **N** if you are finished. The last message will say : **[RETURN SEND MSG, OR <C>ANCEL]**. You will press **RETURN** unless you wish to cancel at this point. The Science Board prompt will be on the screen and you will press **Q** to quit and return to the Main Command Prompt.

SCIENCE BULLETIN BOARD
Saving Messages
With FREDSENDER

It is usually more economical to save messages to a disk and read them when you are off-line. This is also a good way to make a more permanent record of your message.

Before you go online have a formatted data disk in drive 2. Your FREDSENDER program disk does not have enough room on it to serve as a data disk. Next, you must get to the Science Bulletin Board. At the menu: **[SCI: BEHKRSTQ?]** choose **R** to read your mail. As before, you will read the message that has been sent with the attached file. You will be asked if you would like to retrieve the attached file. You will be given a choice as to what procedure you would like to follow: You should choose **X** for X-modem. (Some may choose the **T** for text --however most users of FREDMAILER have discovered the X-modem is better.) On your screen you will see:
TELL YOUR COMPUTER TO RECEIVE TEXT, THEN PRESS RETURN.
In order for FREDSENDER to save or capture your message you must press **ESC.** The strip line menu will appear at the top of your screen. Press **C** for Capture. The strip line menu will say: **CAPTURE FILE NAME:**
If you are using X-MODEM, the name of the file is followed by a comma and an X. (To make a file named "sample" you would type: **sample, x** and then **RETURN.**) If you are doing a text capture, type a file name with no spaces in the name and press **RETURN.** When the file transfer is complete, you will see this message in the strip line menu: **<EOF> (END OF FILE . . . TURN OFF <C>APTURE NOW):**
Press **ESC** to get the strip menu and then press the letter **C** and **RETURN**. When the Science Board Prompt appears on the screen: **[SCI: BEHKRSTQ?]** type **Q** to return to the Main Command Prompt.

Preparing Files for Transmission Using FREDWRITER
(Making a New File)

Place FREDWRITER in drive 1 and a formatted data disk in drive 2. At the main menu, select to start FREDWRITER and **RETURN**. Continue pressing **RETURN** to get past the credits screen. When you have a blank screen with an inverse video strip across the top, you are ready for business.

You should follow these directions to prepare the form for the WEATHERLINKER files. Use the form in the Telecommunications Section as a guide and begin typing on the screen, as with any word processor. When you have finished the form you will want to save it to your data disk. To do this press your **OPEN APPLE** and the **S** key (for save) at the same time. At the bottom of your screen you will see the following message: **<S>AVE (?=CATALOG):**
You type a slash - the name of your data disk - a slash, followed by the filename you wish to give the file you have just prepared. It might look like this:
/DATA/WEATHERLINKER. DATA is the name of the disk and WEATHERLINKER is the name of the file. The computer will know from your message on which disk you would like to save this text.
CONTROL KEY and N will clear your screen after you have finished. If you like, you may create another file and save it.

CONTROL KEY AND Q will end your word processing session. You will be asked if you would like to return to the main menu. You answer **Y**.

If you would like to stop completely, simply take your disks out of your computer and turn everything off. However, if you would like to go directly to FREDSENDER , you will be told to place FREDSENDER in drive 1 and press **RETURN.** The following message will be displayed:

ENTER PREFIX (PRESS "RETURN " TO ACCEPT)

You will press **RETURN** to accept **/FRED/.**

ENTER PATHNAME OF NEXT APPLICATION

You will type **PRODOS** and **RETURN**. The FREDSENDER menu should appear.

Preparing Files for Transmission Using FREDWRITER
(Using a Saved File)

Follow these directions to load a saved file from your data disk and use it to prepare a new file. FREDWRITER is in drive 1 and your data disk is in drive 2. As before, select to start FREDWRITER from the main menu and then press RETURN until you to get to the writing screen.

Press the **CONTROL KEY** and the letter **L** (load) at the same time to load a file into the computer from the data disk. At the bottom of the screen you will see the following message: **<L>OAD (?=CATALOG):**

Your data disk has a file saved on it. This is probably the template or form you will use to organize the weather data you will exchange with others (See FORMAT FOR WEATHERLINKER FILES). You could call the file **WEATHERLINKER**. In order to get it into the computer, you must type: **/DATA/WEATHERLINKER**
DATA is the name of the data disk and WEATHERLINKER is the name of the file.
Immediately, the file will load and you will see the last lines of text in the file. To get to the beginning, press the **CONTROL KEY** and the letter **B** at the same time.

****

If you have forgotten the name of your saved file, you may catalog (the table of contents) your data disk. To do this, you will type **?,D2.** This tells the computer to look at the disk in drive 2. On the screen you will see a list of the files on the data disk. You are told to **RETURN.** At the bottom of the screen you see the following:
<L>OAD (?=CATALOG):
You type in the name of the file you want to use, exactly as it is listed in the catalog, and **RETURN**.
Immediately, the file will load and you will see the last lines of text in the file. To get to the beginning, press the **CONTROL KEY** and the letter **B** at the same time.

****

With your file loaded into the computer, you may add your weather data to the file. To move from line to line, use your up/down arrow keys.

When you have finished entering your data, you will want to save this file to your data disk. To do this, press your **OPEN APPLE** and the letter **S** at the same time.
The following message will appear at the bottom of the screen:
<S>AVE (?=CATALOG): /DATA/WEATHERLINKER

DO NOT PRESS RETURN!! Pressing return at this time will delete your original file and put your newly created one in its place. You will need your original file each day of the project in order to be consistent in organizing your data. You will need to give this new file a different name. You could name it DAY.1, or MAY.3, or FIRST, or whatever you like. At the bottom of the screen you could have something like the following:
<S>AVE (?=CATALOG): /DATA/MONDAY

You have named the data disk where you would like to save the file (DATA) and you have named your file (MONDAY). Now you **RETURN** and the file is saved. You will use this filename when you upload it with FREDSENDER. Try to remember it!

Printing a File

In order to print a file, you will have to have FREDWRITER or FREDSENDER in drive 1 and your data disk in drive 2 . If you use FREDSENDER, choose FREDWRITER from the main menu. If using FREDWRITER, you will select to start the program from the main menu. When you are in the program you must load the file you wish to print into the computer. It should be saved with a filename on the data disk.

Press the **CONTROL KEY** and the letter **L** (load) at the same time to load a file into the computer from the data disk. At the bottom of the screen you will see the following message:
<L>OAD (?=CATALOG):
Type in the name you gave your file while online. This might be something like this:
/DATA/TUESDAY

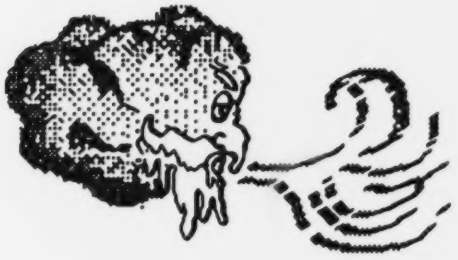
DATA is the name of the data disk and TUESDAY is the name of the file. Immediately, the file will load and you will see the last lines of text in the file. To get to the beginning, press the **CONTROL KEY** and the letter **B** at the same time.

To print the file, turn on your printer, press **CONTROL KEY** and **P** at the same time. When the print menu is showing on the screen, press **RETURN.** Your printer should start printing.

If you know how to use a word processor, you might want to clean up your file before printing by adding or deleting some text.

SUGGESTED MATERIALS

SECTION D



LIST OF SUGGESTED MATERIALS

(The following materials were used by the eight field-testing sites. Since that time, other materials may be available which would be just as appropriate. Thermometers have not been included because most science classrooms already have these on hand. If Celsius and Fahrenheit thermometers are not available, they are required items for this project!) Star indicates MUST HAVES!!

★ **WEATHERLINKER Manual.** NC Dept. of Public Instruction

★ **WEATHERLINKER Video.** NC Dept. of Public Instruction (or similar substitute)

★ **WEATHERLINKER Diskette.** NC Dept. of Public Instruction

★ **FREDSENDER Communications Program.** Public Domain. (or similar substitute)

★ **FREDWRITER Word Processing Program.** Public Domain. (or similar substitute)

★ **Weather Forecasting Computer Software.** Prentice-Hall. $69.00 (or similar substitute)

★ **Science Toolkit Computer Software.** Broderbund. $89.95 (or similar substitute)

★ **12' Shielded Hi-Fi Phono Extention Cable.** Radio Shack. $3.19 (or similar substitute)

★ **Cloud Chart.** Science Associates. $2.50 (or similar substitute)

★ **Castles in the Sky Filmstrip.** Ward's. $7.70 (or similar substitute)

★ **Silva Polaris Compass.** Fisher Scientific. $10.25 (or similar substitute)

★ **Barometer.** Ward's. $19.98 (or similar substitute)

★ **Wind Speed/Rainfall Indicator.** Ward's $5.95 (or similar substitute)

Assorted Weather Publications from U.S. Dept. of Commerce. Superintendent of Documents. (Check with local weather station)

How the Weather Works. H. Michael Mogil. $4.25

Ranger Rick's NatureScope: Wild About Weather. National Wildlife Federation. $6.00

Peterson's Field Guide to the Atmosphere. Houghton-Mifflin. $10.70

Weather Forecaster. Ward's. $3.00

The WeatherCycler. The Weather School. $6.95

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